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BOOM EVENT ANALYZER RECORDER (BEAR): System Description

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FOR THE COMMANDER

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From Oct 1985 to Aug 1989 AAMRL/BBE developed, tested, built and used in field studies several Boom Event Analyzer Recorders (BEARs). These BEAR's operate unattended to capture the wave form of Impulsive Acoustic Events (e.q. Sonic Booms) and their time of occurance while excluding all other acoustic events. These BEARs are designed to operate unattended for up to 10 days and can store over 50 normal (less than ?250 miliseconds in duration) sonic booms. These BEAR systems have been used successfully to capture the sonic boom signature from all US supersonic aircraft. This report is a complete system description of the BEAR covering data collection, theory of operation, data storage and retrieval, operation and complete hardware and software description. The comparison test done in cooperation with NASA and field studies using these BEARs are detailed in companion reports.

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PREFACE

This report is a technical manual describing the Boom Event Analyzer Recorder (BEAR) that was built by Systems Research Laboratories under contract to the Armstrong Aerospace Medical Research Laboratory at Wright-Patterson Air Force Base, Ohio. This development was conducted by the Biodynamic Environment Branch (AAMRL/BBE) under Task 723134, "Exploratory Noise and Sonic Boom Research". Partial funding for this effort was received from the Noise and Sonic Boom Impact Technology (NSBIT) advanced development program office under Project 3037.

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1. INTRODUCTION

1.1 System Description

The Boom Event Analyzer Recorder (BEAR) is a 16 bit microprocessor based instrument that continuously samples the background noise then captures and stores the digital waveform of any loud impulsive noise. The recorder can discern a sonic boom from the normal background noise and capture it in permanent solid state random access memory (RAM) storage for later analysis.

The BEAR digitizes the noise environment at 8 kHz and analyzes it during the downtime between the sampling intervals (125 microseconds) giving it real time screening for sonic boom events. The BFAR examines the event level, duration, positive pulse time and risetime to determine if it should be stored as a boom event. These four parameters are selectable via the input key pad to make the BEAR a very flexible instrument with which to capture a wide variety of impulsive events. Along with setting the boom evaluation criteria, the key pad allows input of date, time, test number, location and serial number of the unit. This information is stored in the same RAM modules as data every time any parameter is changed. The operator can also select two other modes from this key pad: calibration or data save. In the calibration mode the BEAR simply displays the root-mean-square level of two seconds of the input signal to the microphone for checking against a standard 124 dB sound pressure level pistonphone calibrator. No data is saved to the RAM modules in this mode. The second mode allows the operator to collect one second of data with no screening. This allows the operator to collect and store background noise, the calibrator signal or anything else that is desired. The BFAR unit, upon startup, runs through an internal self test routine that verifies all the hardware components; then, cues the operator that it is "READY' for date, time and parameter inputs.

The BEAR has a frequency response of 0.5 Hz to 2,500 Hz for reproducing a sonic boom time-history adequate for environmental impact analysis. The maximum overpressure the BEAR can accurately record is 165.3 dB (76.9 pounds per square foot or 3639 pascals) with an 80 dB usable dynamic range. The RAM modules on a single unit have 512K of memory allowing the BEAR to store over 100 "normal" sonic booms (duration of .250 secondS) or 32 "save" events (1 second of data stored via keypad save routine).

The BEAR is designed to operate with a PCB Inc, model # 106850, piezoelectric microphone that is totally sealed and extremely rugged making the BEAR able to operate in the environmental extremes of temperature typical of USAF supersonic areas(0 - 65 degrees C.). This microphone is used with the BEAR systems in an inverted position (see figure 1). This essentially collects the pressure waveform being

BOOM EVENT ANALYZER RECORDER (BEAR)

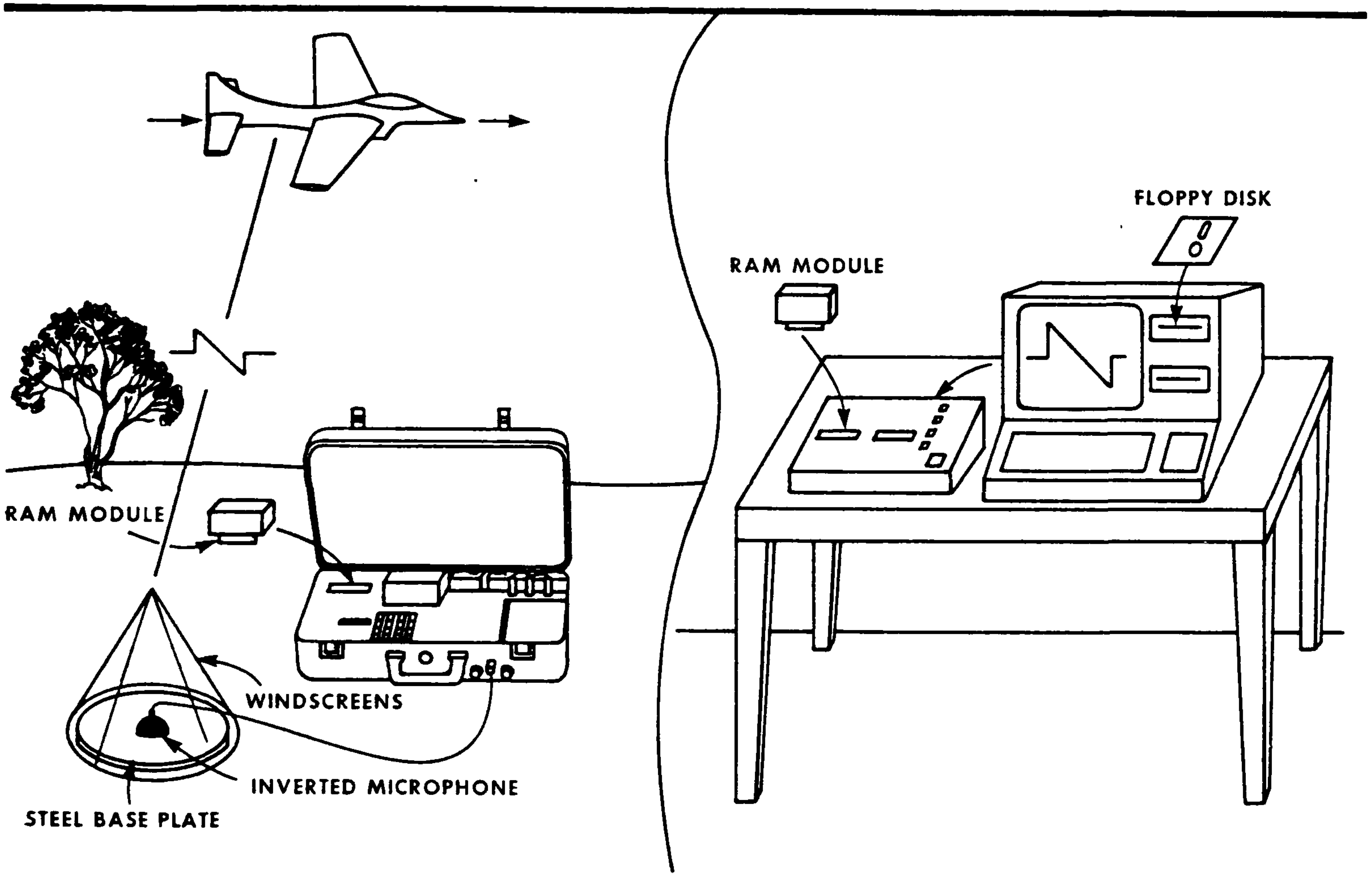

Figure 1. BEAR Data Collection and Transfer

reflected from the steel base plate. This proceedure produces virtually identical results over this frequency range with that measured by a flush mounted microphone and is much easier to set up. The low profile also helps in reducing the wind noise (a major contributor of low frequency noise) to the microphone system. The BEAR system and microphone setup were validated in a test conducted at Edwards AFB, CA in Sep 1986. This validation is described in the report "AAMRL-TR-88-039, AIR FORCE BOOM EVENT ANALYZER RECORDER (BEAR): Comparison with NASA Boom Measurement System, R.Lee, July 1988".

1.2 Companion Hardware/Software

Once data has been collected by the BEAR unit the data is stored on its RAM modules. The RAM modules can then be interfaced with a Data Retrieval Unit (DRU) to transfer the information to a Zenith Z-100 microcomputer (figure 1). The microcomputer displays each recorded event, time of occurrence and summary information for all the data stored. Along with the DRU AMRL/BBE also developed several hardware items and software programs for use with the BEAR systems. These items include a security case, windscreen, sunscreen, battery charger (for proper battery charging) and multiple boom processing programs. Complete descriptions of these are detailed in the following appendices:

Appendix A. Data Retrieval Unit (DRU)
Appendix B. BEAR Software Programs (BEARWARE)
Appendix C. BEAR additional Hardware

2. THEORY OF OPERATION

2.1 Start-up Routine

The BEAR is designed such that after turning the unit on it will do an internal self analysis and come up ready to capture sonic boom data. This internal analysis checks the BEAR EPROM, all internal hardware operation, and the RAM modules. If the RAM modules contain valid data no other check is made to the modules. If the modules are empty the BEAR will write valid data to each address of the modules, read and compare each location, write zero's to all address and verify that the zeros were written. The BEAR will then initialize the RAM modules writing the setup parameters to the first address space. The BEAR will now display a "READY" message and is ready to collect sonic boom data. The BEAR default parameters are set for normal unattended use for the majority of USAF supersonic operations. For this use the operator need only place the unit at the monitoring location, turn it on, set the "A" parameters for current date and time and set the "B" parameters for specific test number and site number for later identification (see section 2.3 Key Pad Operation for a complete description of these functions). This default mode will capture any sonic boom greater than 0.1 PSF (107 dB). If the boom is larger than 76.9 PSF, the BEAR will capture the event but the top of the N wave will be clipped. The BEAR will operate unattended for 1 day on the internal rechargeable small batteries and for 8 days on the 3 external rechargeable batteries. The batteries operating the removable RAM modules are good for approximately 7 years.

2.2 Boom Capture Operation

A normal sonic boom propagating under quiescent atmospheric conditions will produce a typical N-shaped pressure signature as showen in Figure 2. A clean N-wave like this will have a typical rise time of .5 to 5 milliseconds to reach the peak overpressure. Its positive pulse time will be about 1/2 of the total boom duration (typically longer than 50 milliseconds). As a clean boom propagates through atypical or non quiescent atmospheric weather conditions the peak of the N-wave will become ragged as in Figure 3. This can effectively cause the risetime (i.e. time to rise to the signatures peak) to be dramatically increased to the range of 5 to 30 milliseconds and cause a slight shortening of the positive pulse time. If the aircraft is accelerating, decelerating, climbing, diving or turning, the boom signature can become focussed causing an increase in the peaks to be superimposed on the N-wave as per Figure 4. In extreme cases this focusing effect can cause the N-wave to be distorted to a typical U-wave. This will cause a dramatic shortening of the positive pulse time. As a boom approaches the lateral cutoff point (the point on the ground where the atmospheric conditions have bent the boom

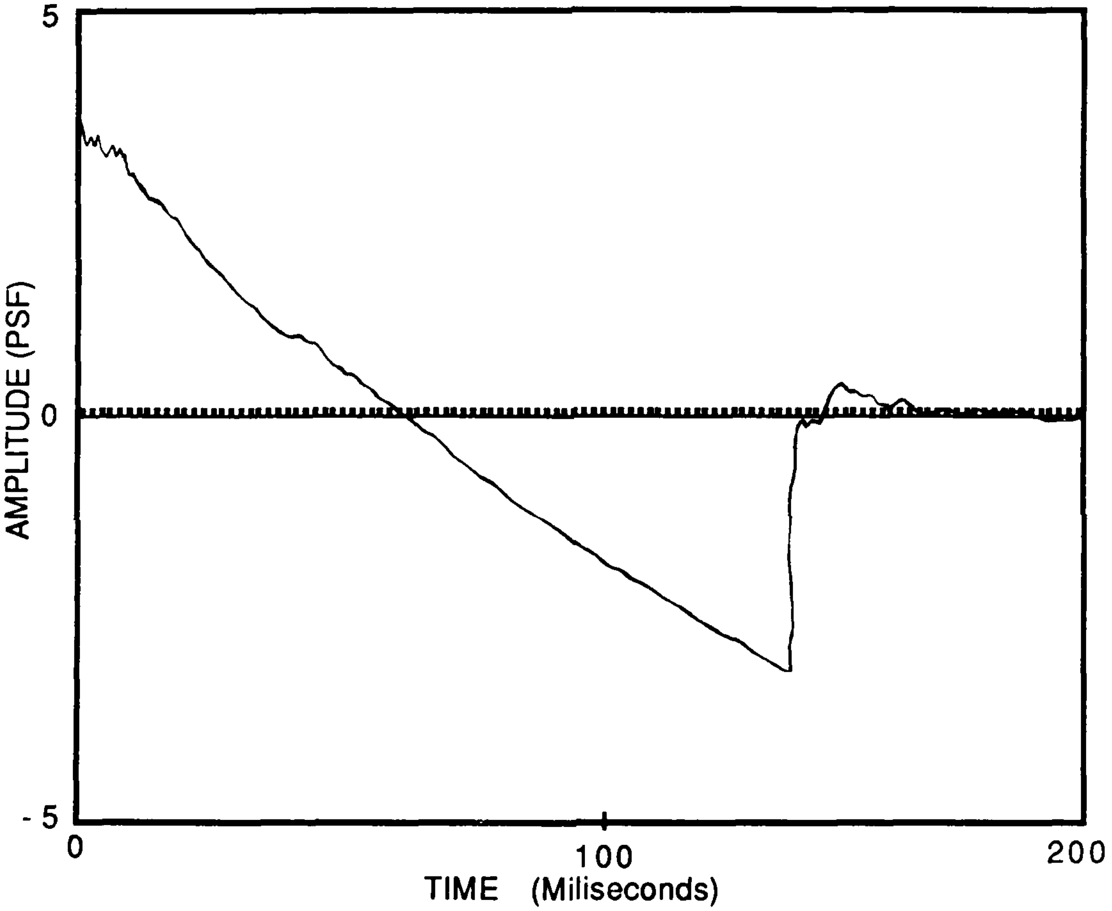

Figure 2. Clean N-Wave

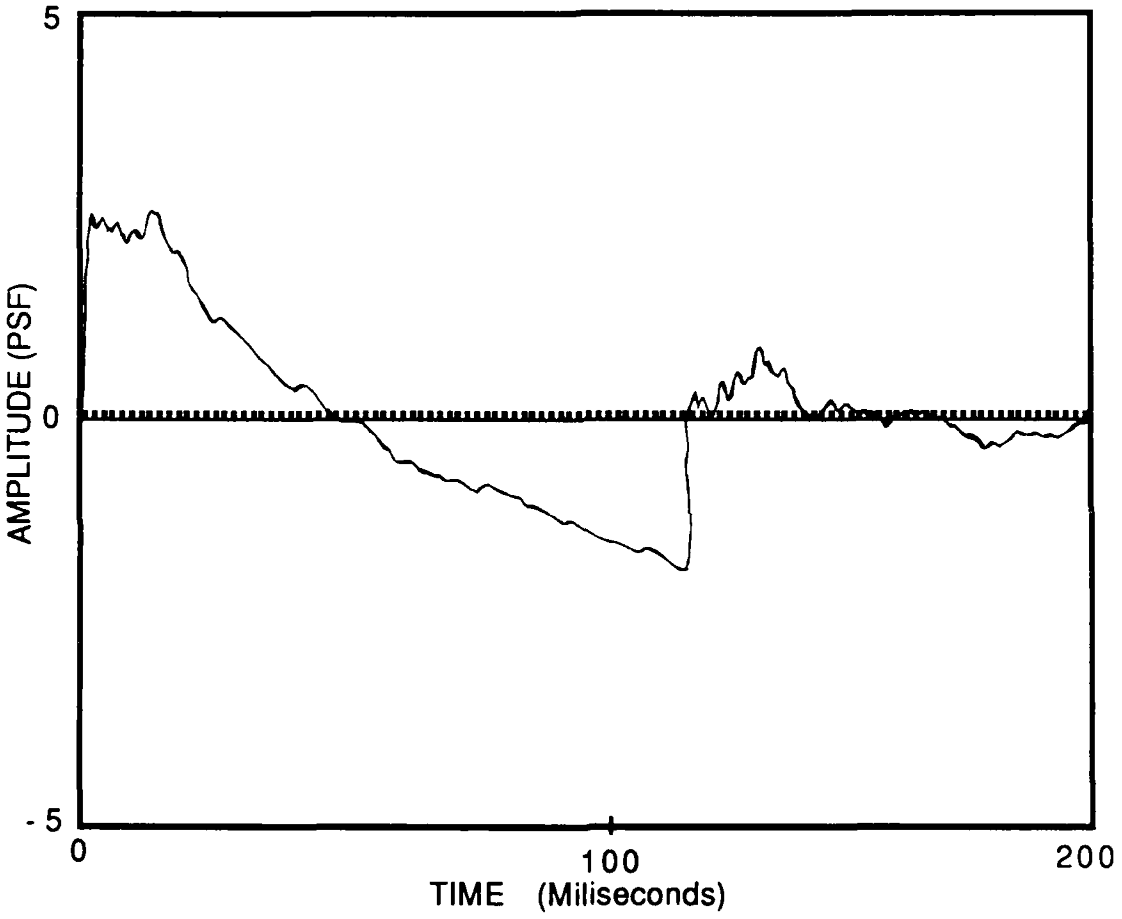

Figure 3. Ragged N-Wave

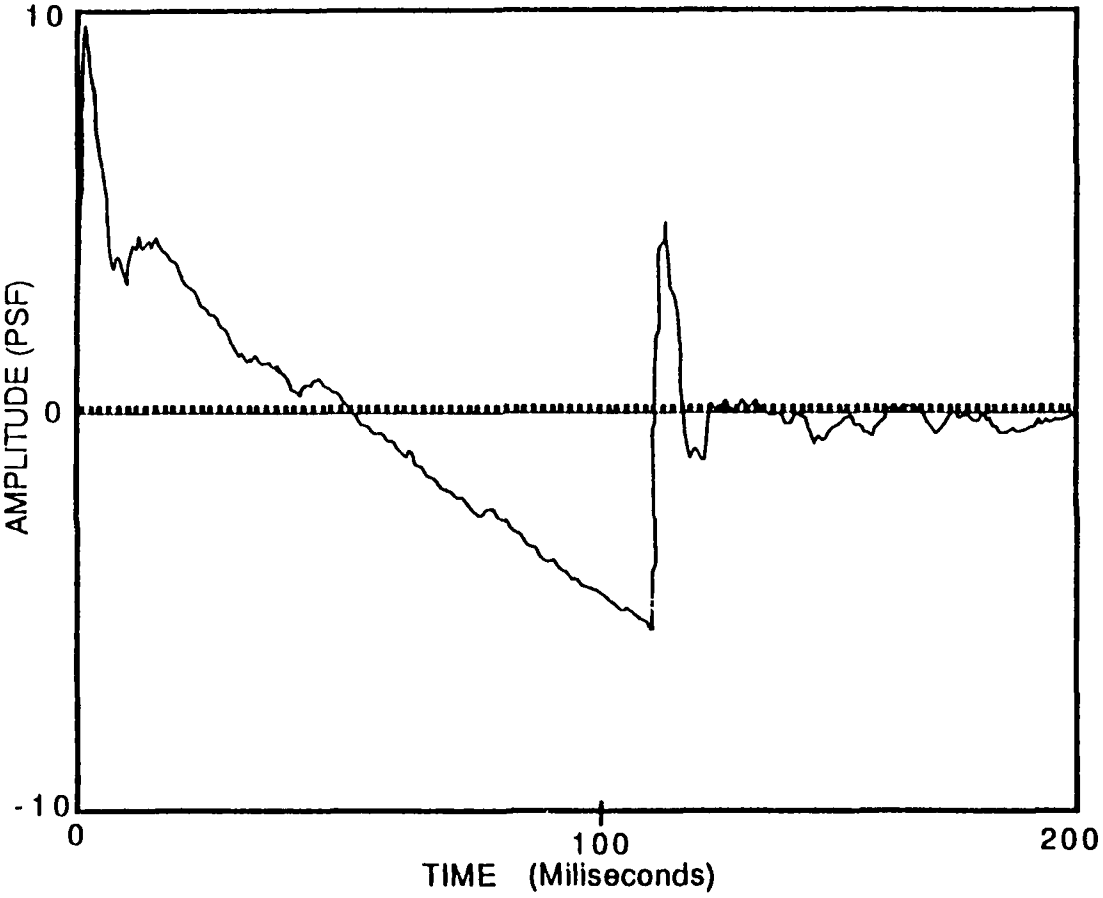

Figure 4. Focussed N-Wave

ray path upward), it is refracted up and away from the ground causing the boom to degenerate into non-impulsive subsonic noise. Figure 5 is a boom signature very close to the lateral cutoff point.

To accomodate this wide variety in sonic boom signatures the BEAR discerns boom events from other noisy events with an internal screening methodology as shown in Figure 6. The BEAR continuously monitors the noise environment, digitizing and examining the noise signature every 125 microseconds. When the noise level rises above the Trigger 2 Level the BEAR considers the signal a possible boom event and starts to write the digitized values to the RAM modules and starts the event timer. As the possible boom event is being stored, the BEAR flags the first local peak, the absolute peak, the absolute negative peak and the last downward threshold (point where signature goes below Trigger 2) crossing. Upon reaching a downward threshold crossing, the BEAR starts the cycle timer. Whenever the signal raises back above the threshold the cycle timer is stopped and reset again on the next down crossing. When either timer times out (reaches the end of its preset time value), the possible boom event is examined for the following three conditions:

1. To have a valid Peak the peak level must be above the Trigger 3 level.

2. To have a valid Positive Pulse the time from the peak to the peak time plus the positive pulse time must have all the data points greater than the Trigger 2 level and the time from the negative peak to the negative peak time minus one third the positive pulse time must have the absolute value of all the data points greater than the Trigger 2 level.

3. The rise time to the absolute peak must be steeper than the input rise time values or the rise time to the first local peak must be steeper than one third of the input rise time value. Specifically, the rise time from the absolute peak is calculated by comparing the data value at the time of (the absolute peak time minus the input risetime time value) to the peak value. This data value must be less than the peak value minus the input rise time dB value. For the first local peak, the value to be compared is found at (the time of the first local peak time minus one third of the input risetime time value). If either of these risetimes pass the test, then the possible boom event is considered to have a valid risetime.

If the event passes all three of these tests, it is considered a valid boom; the "Yes" counter is incriminated by one and the date, time and parameter sets are stored with the event. If the event fails any of the three tests, it is not considered a valid boom; the "No" counter is incriminated by one and the data are allowed to be overwritten by any new incoming data.

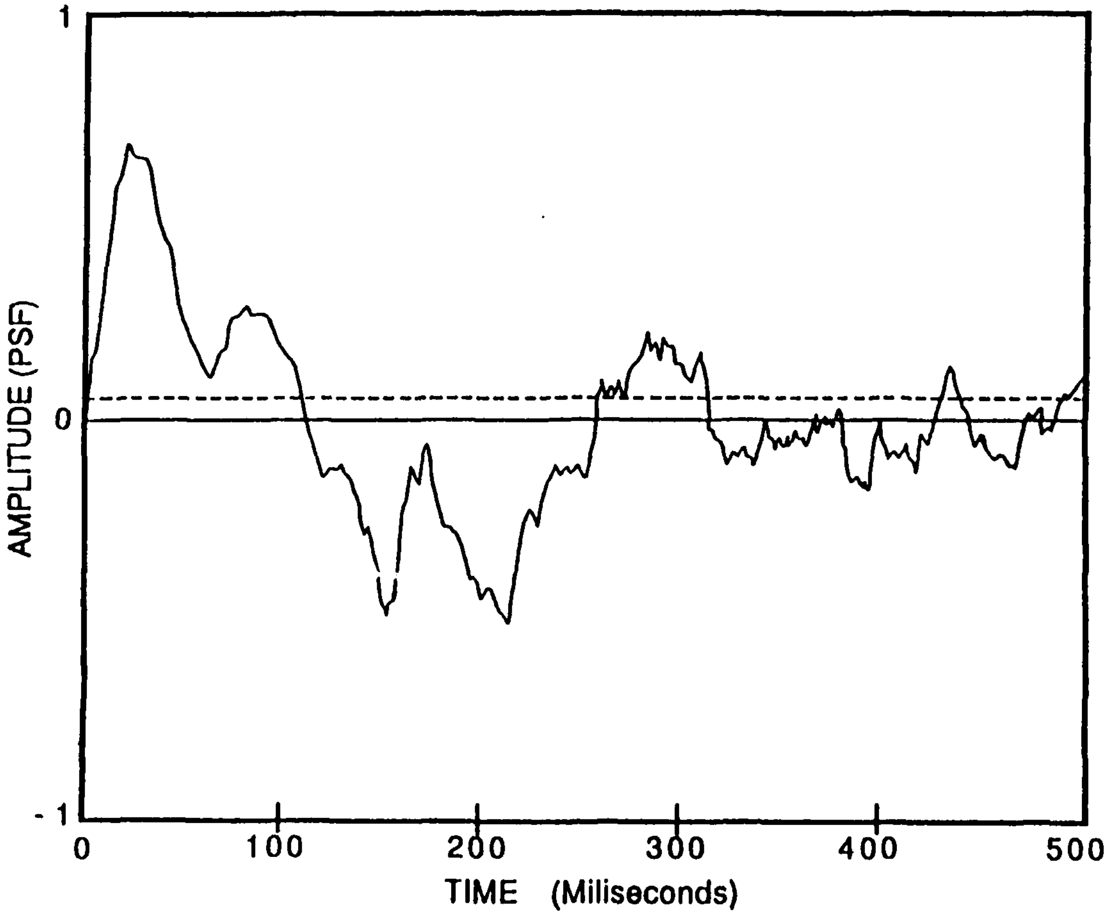

Figure 5. Boom Near Lateral Cutoff

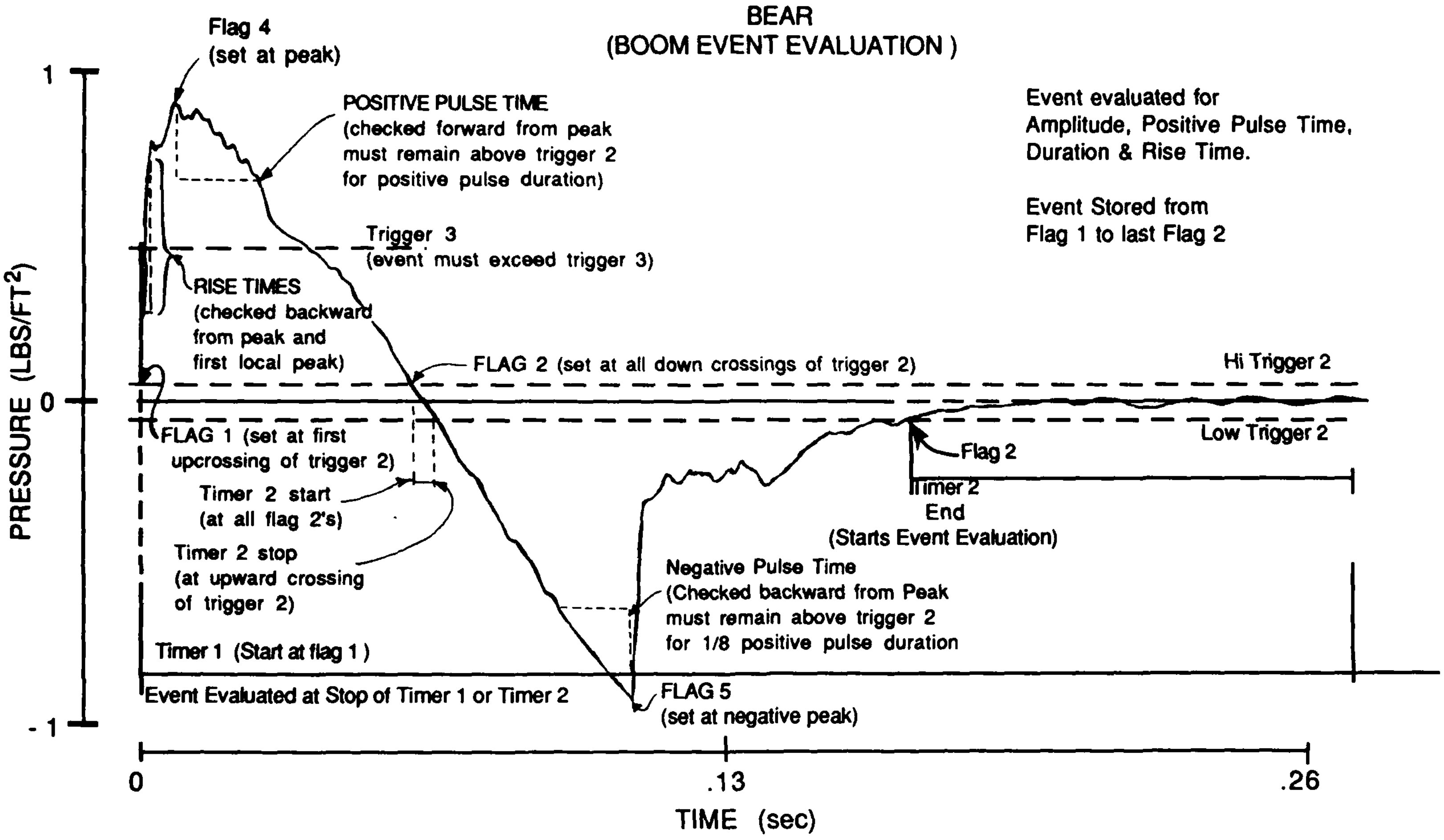

Figure 6. Boom Evaluation Criteria

2.3 Key Pad Operation

The Key Pad allows for the user to perform various functions on the BEAR. The user can set and read date, time, site number, test number, timers, trigger levels, and positive pulse time, read the system calibrator and capture background sample data. These functions are accomplished as follows:

READ TIME

PUSH "*" AND THEN
PUSH "A" AND DISPLAY SHOWS:
YYMMDD.HH.mm.SS
WHERE YY IS THE YEAR ; 00-99
MM IS THE MONTH ; 00-12
DD IS THE DAY ; 00-31
HH IS THE HOUR ; 00-23
mm IS THE MINUTES ; 00-59
SS IS THE SECONDS ; 00-59
THEN PUSH "*" (TURNS OFF DISPLAY)

SET TIME

PUSH "*" AND THEN
PUSH "A" AND THEN (DISPLAY CURRENT REAL TIME)
PUSH "ENT" (CLEARS CURRENT DISPLAY FOR ENTRY)
THEN ENTER REAL TIME IN THE FOLLOWING ORDER:
PUSH DIGIT FOR HIGH YEAR DIGIT; 0-9
PUSH DIGIT FOR LOW YEAR DIGIT; 0-9
PUSH DIGIT FOR HIGH MONTH DIGIT; 0-1
PUSH DIGIT FOR LOW MONTH DIGIT; 0-9
PUSH DIGIT FOR HIGH DAY DIGIT; 0-3
PUSH DIGIT FOR LOW DAY DIGIT; 0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR HIGH HOURS DIGIT; 0-2 (24 Hour clock)
PUSH DIGIT FOR LOW HOURS DIGIT; 0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR HIGH MINUTES DIGIT; 0-5
PUSH DIGIT FOR LOW MINUTES DIGIT; 0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR HIGH SECONDS; 0-5
PUSH DIGIT FOR LOW SECONDS; 0-9
THEN PUSH "ENT" IF DISPLAY INDICATES DESIRED REAL TIME ENTRY
THEN PUSH "*" (TURNS OFF DISPLAY)

NOTE: IF AN ERROR IS MADE ANY TIME BEFORE THE LAST "ENT", ENTRY,
PUSH "CLR," PUSH "A," PUSH "ENT," AND REENTER DIGITS.

READ STATUS/TIMER

```
PUSH "*" AND THEN
PUSH "B" AND DISPLAY SHOWS:
   TT.SS.T1.T2.SNUM
WHERE
   TT IS THE TEST NUMBER                     ; 00-99
   SS IS THE SITE NUMBER                     ; 00-99
   T1 IS THE EVENT TIMER (TIMER #1)          ; 00-99 SECONDS
   T2 IS THE CYCLE TIMER (TIMER #2)          ; 0.0-9.9 SECONDS
   SNUM IS THE BEAR SERIAL NUMBER            ; 00-3999
THEN PUSH "*" (TURNS OFF DISPLAY)
```

SET STATUS/TIMER

```
     PUSH "*" AND THEN
     PUSH "B" AND THEN (DISPLAY CURRENT STAT/TIMER INFO)
     PUSH "ENT" (CLEARS CURRENT DISPLAY FOR ENTRY)
     PUSH DIGIT FOR HIGH TEST NUMBER DIGIT      ; 0-9
     PUSH DIGIT FOR LOW TEST NUMBER DIGIT       ; 0-9
     PUSH "." (DECIMAL POINT)
     PUSH DIGIT FOR HIGH SITE NUMBER DIGIT      ; 0-9
     PUSH DIGIT FOR LOW SITE NUMBER DIGIT       ; 0-9
     PUSH "." (DECIMAL POINT)
     PUSH DIGIT FOR TIMER #1 HIGH DIGIT  (TENS OF SECONDS);
0-9
     PUSH DIGIT FOR TIMER #1 LOW DIGIT   (SECONDS); 0-9
     PUSH "." (DECIMAL POINT)
     PUSH DIGIT FOR TIMER #2 HIGH DIGIT  (SECONDS); 0-9
     PUSH DIGIT FOR TIMER #2 LOW DIGIT   (TENTHS OF SECONDS);
0-9
     PUSH "." (DECIMAL POINT)
     PUSH DIGIT 1 OF SERIAL NUMBER
     PUSH DIGIT 2 OF SERIAL NUMBER
     PUSH DIGIT 3 OF SERIAL NUMBER
     PUSH DIGIT 4 OF SERIAL NUMBER
     PUSH "ENT" IF DISPLAY INDICATES DESIRED STAT/TIMER DATA.
     PUSH "*" (TURNS OFF DISPLAY)
```

NOTE: IF AN ERROR IS MADE ANY TIME BEFORE THE LAST "ENT" ENTRY,
PUSH "CLR," PUSH "B," PUSH "ENT," AND REENTER DIGITS.

CALIBRATION MODE

PUSH "C"

SELECT "1" OR "2"

IF "1" IS SELECTED THE SYSTEM WILL THEN CONTINUOUSLY READ THE INPUT DATA, CONVERT IT TO ITS CORRESPONDING dB VALUE, AND DISPLAY IT. THIS WILL CONTINUE UNTIL THE DISPLAY IS TURNED OFF.

IF "2" IS SELECTED THE SYSTEM WILL THEN CONTINUOUSLY READ THE INPUT DATA AND DISPLAY THE HEX VALUE OF THE OUTPUT OF THE A/D CONVERTER. THIS VALUE IS UPDATED TO THE DISPLAY EVERY 1/2 SECOND.

PUSH "*" TO TURN OFF THE DISPLAY.

NOTE: THIS CALIBRATION MODE ONLY DISPLAYS ACCURATE RMS VALUES FOR AN INPUT RANGE OF 115 dB TO 135 dB SPL DUE TO ROUND OFF AND OVERFLOW IN THE 68000 MICROPROCESSOR.

READ BOOM PARAMETER VALUES

```
PUSH "*" AND THEN
PUSH "D" AND DISPLAY SHOWS:
   TR3.TR2.PP.RV.RT
WHERE TR3 IS THE 3 DIGIT TRIGGER #3 VALUE ; 000-199
           (MINIMUM PEAK IN dB)
      TR2 IS THE 3 DIGIT TRIGGER #2 VALUE ; 000-199
           (THRESHOLD IN dB)
      PP IS THE 2 DIGIT POSITIVE PULSE VALUE ; 00-99
           (IN MILLISECONDS)
      RV IS THE 2 DIGIT RISETIME VALUE ; 00-99
           (IN dB)
      RT IS THE 2 DIGIT RISETIME ; 00-99
           (COUNTED BACKWARDS FROM THE PEAK IN
            MILLISECONDS)
THEN PUSH "*" (TURNS OFF DISPLAY)
```

SET BOOM PARAMETER VALUES

```
PUSH "*" AND THEN
PUSH "D" AND THEN (DISPLAY CURRENT VALUES)
PUSH "ENT" (CLEARS CURRENT DISPLAY FOR ENTRY)
PUSH DIGIT FOR HIGHEST DIGIT OF TRIGGER #3;          0-1
PUSH DIGIT FOR MIDDLE DIGIT OF TRIGGER #3;           0-9
PUSH DIGIT FOR LOWEST DIGIT OF TRIGGER #3;           0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR HIGHEST DIGIT OF TRIGGER #2;          0-1
PUSH DIGIT FOR MIDDLE DIGIT OF TRIGGER #2;           0-9
PUSH DIGIT FOR LOWEST DIGIT OF TRIGGER #2;           0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR HIGH DIGIT OF POSITIVE PULSE VALUE
                          (TENS OF MILLISECONDS);    0-9
PUSH DIGIT FOR LOW DIGIT OF POSITIVE PULSE VALUE
                                  (MILLISECONDS);    0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR HIGH DIGIT OF RISETIME dB VALUE;      0-9
PUSH DIGIT FOR LOW DIGIT OF RISETIME dB VALUE;       0-9
PUSH "." (DECIMAL POINT)
PUSH DIGIT FOR HIGH DIGIT OF RISETIME
                          (TENS OF MILLISECONDS);    0-9
PUSH DIGIT FOR LOW DIGIT OF RISETIME (MILLISECONDS); 0-9
THEN PUSH "ENT" IF DISPLAY INDICATES DESIRED SOFTWARE
   ANALYSIS PARAMETER VALUES
THEN PUSH "*" (TURNS OFF DISPLAY)
```

NOTE: IF AN ERROR IS MADE ANY TIME BEFORE THE LAST "ENT" ENTRY,

PUSH "CLR," PUSH "D," PUSH "ENT," AND REENTER DIGITS.

READ MEMORY REMAINING

PUSH "*" AND THEN
PUSH "E" THE SYSTEM WILL DISPLAY THE AMOUNT OF DATA STORAGE MEMORY REMAINING ON THE CURRENT MODULE PAIR.

SAVE DATA MODE

PUSH "*" AND THEN
PUSH "F" THE SYSTEM WILL SAVE THE NEXT 7661 DATA POINTS FROM THE TIME OF PRESSING THE "F" KEY. THESE DATA ARE SAVED JUST LIKE A NORMAL BOOM EVENT BY STAMPING THE DATE, TIME, SITE NUMBER, TEST NUMBER AND ALL THE PARAMETER SETS AT THE END OF THE SAVED DATA FILE. WHEN THE SYSTEM IS FINISHED SAVING DATA IT AUTOMATICALLY RETURNS TO THE NORMAL DATA ACQUISITION MODE DISPLAYING THE "XXX YES/NO XXX" COUNTER.

2.4 Parameter Ranges and Default Settings

ALLOWABLE PARAMETER SETTINGS

The following are the allowable ranges for input to the BEAR. Parameters set outside these ranges will cause the BEAR to not accept the input for that line of information. The correct information must then be reentered.

KEY	READ	SET		RANGE ALLOWED
B	X	X	TIMER #1	00-99
B	X	X	TIMER #2	00-99
B	X	X	TEST NUMBER	00-99
B	X	X	TEST SITE NUMBER	00-99
B	X	X	BEAR SERIAL NUMBER	00-3999
D	X	X	POSITIVE PULSE VALUE	00-99
D	X	X	TRIGGER #2	000-199
D	X	X	TRIGGER #3	000-199
D	X	X	RISETIME dB	00-99
D	X	X	RISETIME TIME	00-99

DEFAULT PARAMETER SETTINGS

The date and time must always be set using the A key function on power up of the BEAR. The boom capture parameters will be set upon successful power up to the following defaults that will allow capture of most normal sonic booms.

POSITIVE PULSE VALUE	.10 SECONDS
TRIGGER #2	100 dB
TRIGGER #3	107 dB
TIMER #1	2 SECONDS
TIMER #2	.2 SECONDS
RISETIME dB	6 dB
RISETIME TIME	.35 SECONDS
TEST NUMBER	00
SITE NUMBER	00
SERIAL NUMBER	0000

3. BEAR SOFTWARE DESCRIPTION

3.1 Overview

The Boom Event Analyzer Recorder (BEAR) is a software controlled instrument that digitizes acoustic signals and analyzes them using programmable parameters to determine if the signal was a sonic boom. The data of an event are retained in the removable battery RAM modules that can be later processed for further analyses. The software was written in 68000 assembler language and is detailed in the Software block diagram (Figure 7.). The devices that are being controlled are:

- 16 bit A/D being sampled at 8 Khz.
- Keypad for parameter entry.
- Alphanumeric display for parameter display and error messages.
- Real-time clock for time and date information.
- Two programmable timers for defining event windows.

3.2 Startup

As described in the software block diagram, the system first performs diagnostics when the power is applied. Checks are made on the EPROMs, static RAM, and battery RAM modules. An error message is displayed if the test fails. The next function performed is the initialization of the display, timers, and the real-time clock. The timers and real-time clock are initialized with the default parameters. The initial parameter list is also stored in the battery RAM. Finally, the interrupts are enabled and the software goes into a wait loop for either an A/D interrupt, keypad interrupt, or a timer interrupt. When a A/D interrupt is detected, the digitized data are read and compared to the threshold value. If below the threshold, the data are processed by the running average table routine which averages the background noise over a 2 second period. If the data are above the threshold, a new event is triggered and data recording begins. At the beginning of the event, timers 1 and 2 are activated to determine the end of the event.

When a keypad interrupt is detected, "KEYPAD" reads and parses the key entered. The first key that must be entered is the display on/off key (*). While the display is on, the A/D interrupt routine (DAC) does not process A/D data. The next key that must be entered is a function key. The allowable functions are:

- Set Real-Time Clock
- Set Status and Timers
- Enter Calibration Mode
- Set Boom Identification Parameters
- Read Memory Remaining
- Enter Data Capture Mode

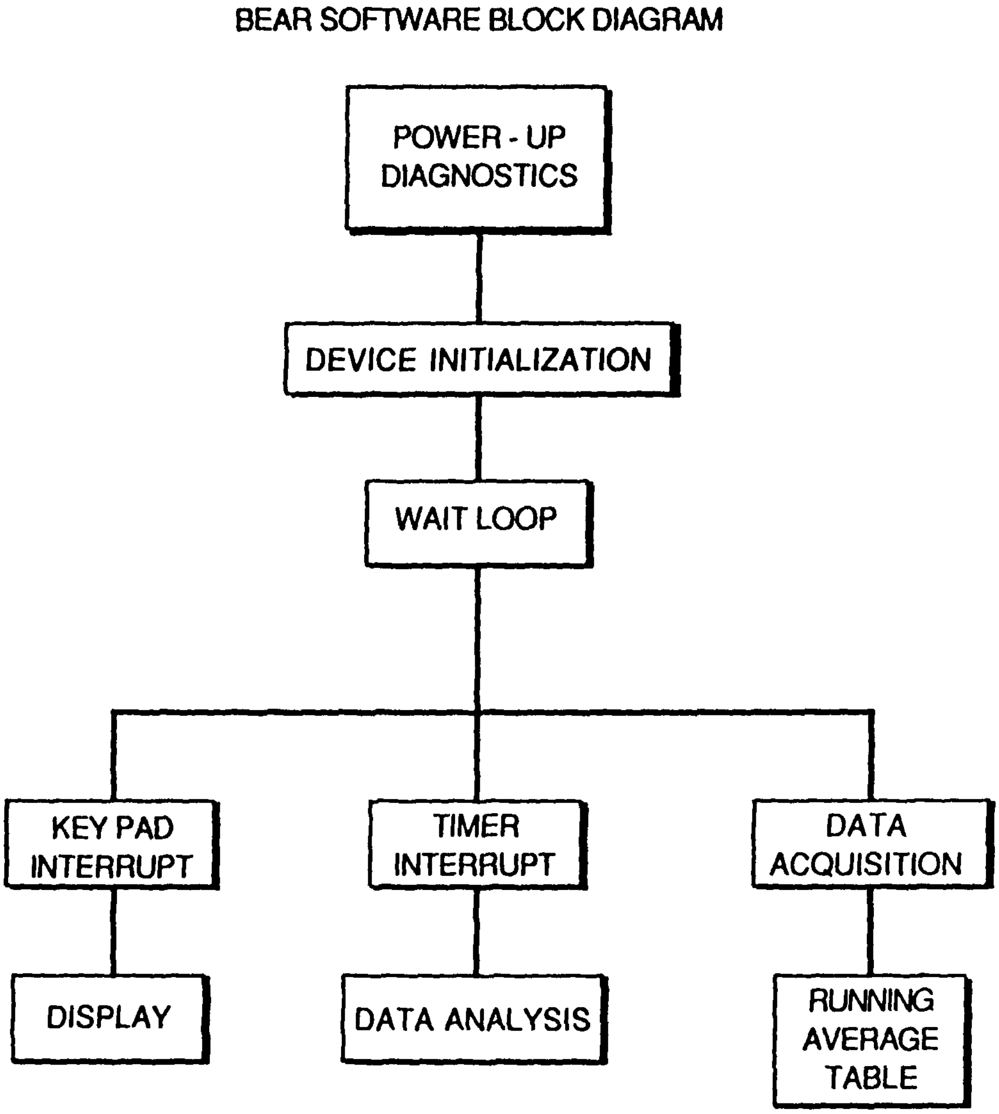

Figure 7. BEAR Software Block Diagram

Once the function key is entered, the current values for that function are displayed. If new parameter values are to be entered, the "ENT" key must be pressed followed by the values. All parameter changes are recorded in battery RAM for analysis purposes. If parameter changes are not required, the on/off key (*) may be pressed; the display is turned off; and the event data continues to be processed. If any invalid keypad entry is detected, "KEYPAD" will display an error message.

When a timer interrupt is detected, it indicates the end of an event. The event is analyzed to determine if it was a valid sonic boom or not. Either timer 1 or 2 will cause the interrupt to occur; if timer 1 was the cause, the event will be checked to determine if the peak was within 100 ms of the end. If it was timer 1 will be extended by 100 ms. If not the event will be evaluated to determine if it is a sonic boom. The other tests performed in validating the data are: the peak signal must be high enough, and the slope of the peak must be fast enough. If the event is determined to be a valid sonic boom, the data are retained and the current time and date along with the running average value are recorded at the end of the data file. The "YES" event message counter is also incriminated. If the event was invalid, the data file pointer is reset to the beginning of the file, and the next event will record over the data. The "NO" event message counter is also incriminated. Events will continue to be recorded until the battery RAM is filled at which time the "BAT RAM FULL" message is displayed and event processing is halted. If any errors are detected by the system during power-up diagnostics or parameter entry, appropriate error messages are displayed. All error recovery procedures are explained in section 3.6.

3.3 System Initialization

The BEAR software program has two methods of initializing the system. If the system was powered on with new battery RAM modules installed, the EPROMs are checked, the battery RAMs are checked and zeroed, the status RAM is checked, and the I/O devices are initialized. If the BEAR system is powered on with valid data existing in the battery 8AM modules; the battery RAM diagnostic is bypassed and the system is initialized with the parameter values that existed when the BEAR was powered off. Data storage then begins after the barker code (this is a hexidecimal code of 90 EB 90 EB 90 EB used to separate data entries) of the last valid data block in the battery RAM (see Section 3.5 for examples of how the data is stored).

The first device that is checked is the EPROM. The program sums each location in EPROM and compares the check-sum result with the predetermined value. Next, (only if the RAM modules are without valid data) each byte of static RAM is written with the values AAH, 55H, and zero to verify its integrity. Finally, each byte of battery RAM is written with the values AAH, 55H, and zero. During the battery RAM test, two things are achieved: integrity check of the RAM and zeroing of the RAM. If any errors occur during the diagnostic, an error message is displayed. Once the diagnostics are passed, the program transfers the system constants from either the EPROM or battery RAM (depending on the type of initialization with or without valid boom data already on the RAMs) to static RAM for use by the other routines in the system.

The next device to be initialized is the Peripheral Interface Adaptor (PIA) chip. This allows I/O transfer between the CPU and the display, keyboard, real-time clock, and the timers. This also determines the circumstances for generating an interrupt. Once the PIA is initialized, the real-time clock, timers, and display are initialized. Finally, the interrupts are enabled and the system waits for any interrupt to occur. The possible interrupts and their vectors are:

- Vector 2, DAC, A/D Interrupt
- Vector 5, KEYPD, Key pad Interrupt
- Vector 6, TIMER, Timer Interrupt

See Figures 8-10 for System Initialization Flow Chart.

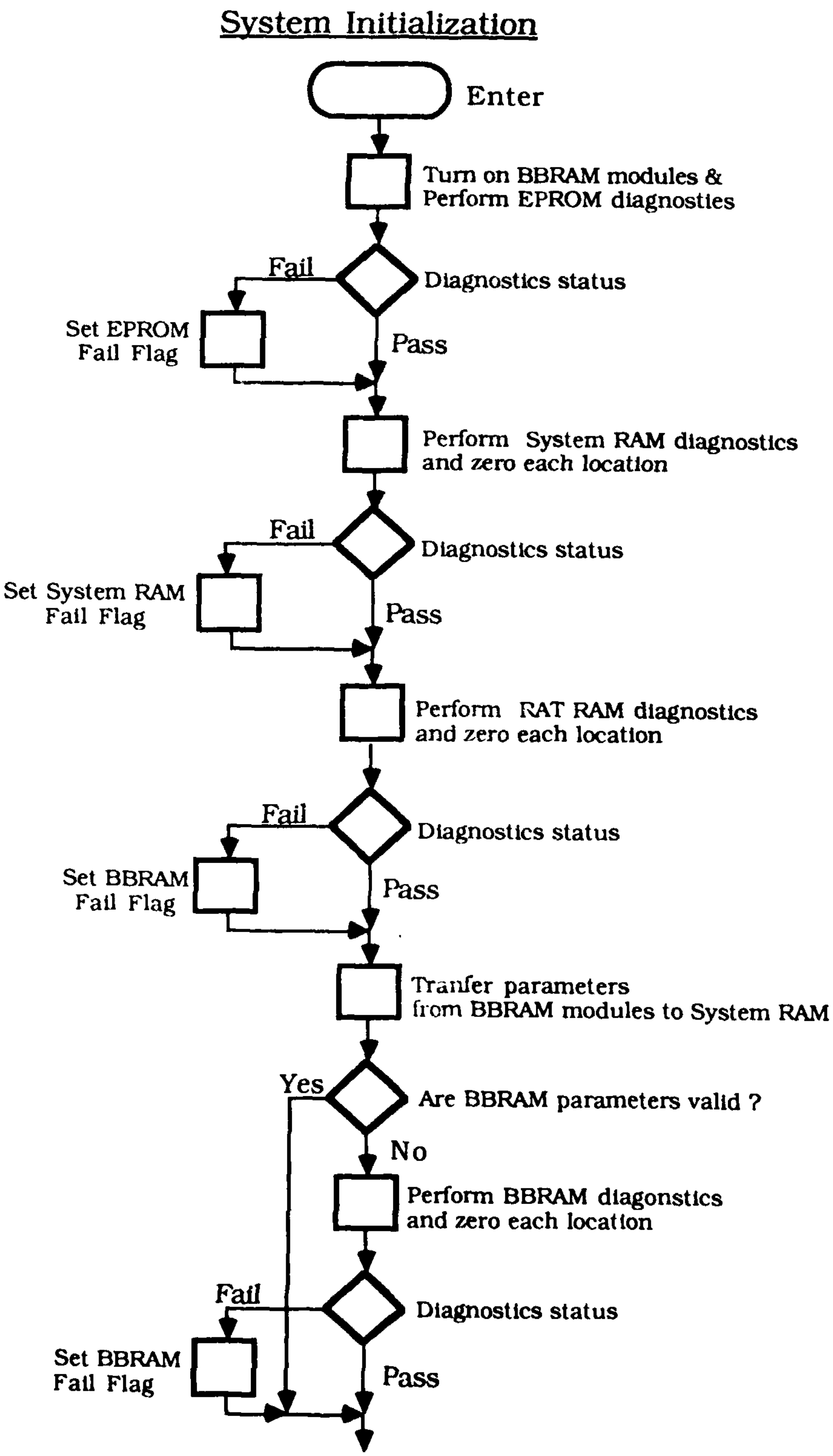

Figure 8. BEAR System Initialization Flow Chart

System Initialization

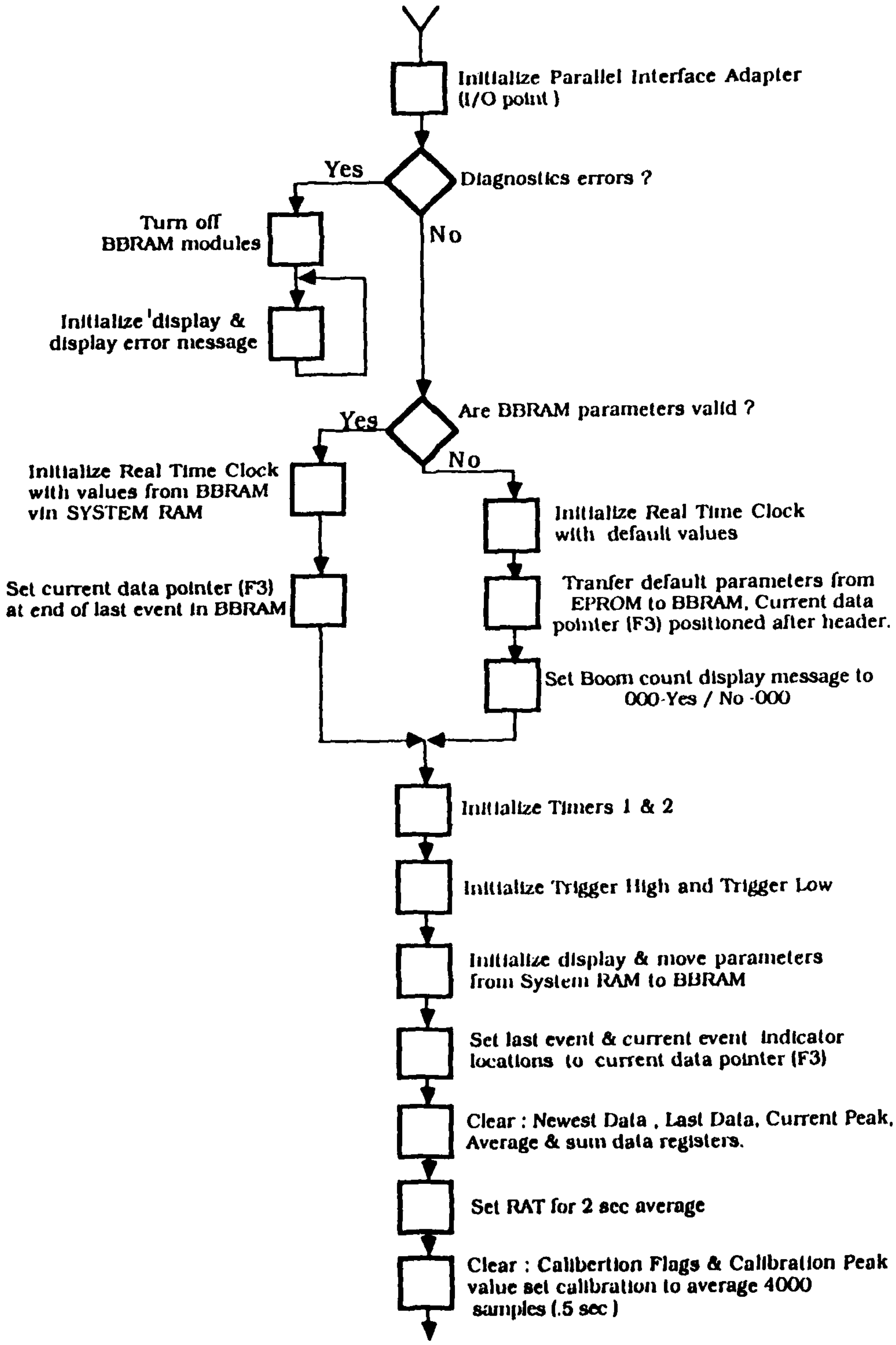
Initialize Parallel Interface Adapter (I/O point)
Diagnostics errors ?
Yes
No
Turn off BBRAM modules
Initialize 'display & display error message
Are BBRAM parameters valid ?
Yes
No
Initialize Real Time Clock with values from BBRAM via SYSTEM RAM
Set current data pointer (F3) at end of last event in BBRAM
Initialize Real Time Clock with default values
Tranfer default parameters from EPROM to BBRAM. Current data pointer (F3) positioned after header.
Set Boom count display message to 000-Yes / No -000
Initialize Timers 1 & 2
Initialize Trigger High and Trigger Low
Initialize display & move parameters from System RAM to BBRAM
Set last event & current event indicator locations to current data pointer (F3)
Clear : Newest Data , Last Data, Current Peak, Average & sum data registers.
Set RAT for 2 sec average
Clear : Calibertion Flags & Calibration Peak value set calibration to average 4000 samples (.5 sec)

Figure 9. BEAR System Initialization Flow Chart (continued)

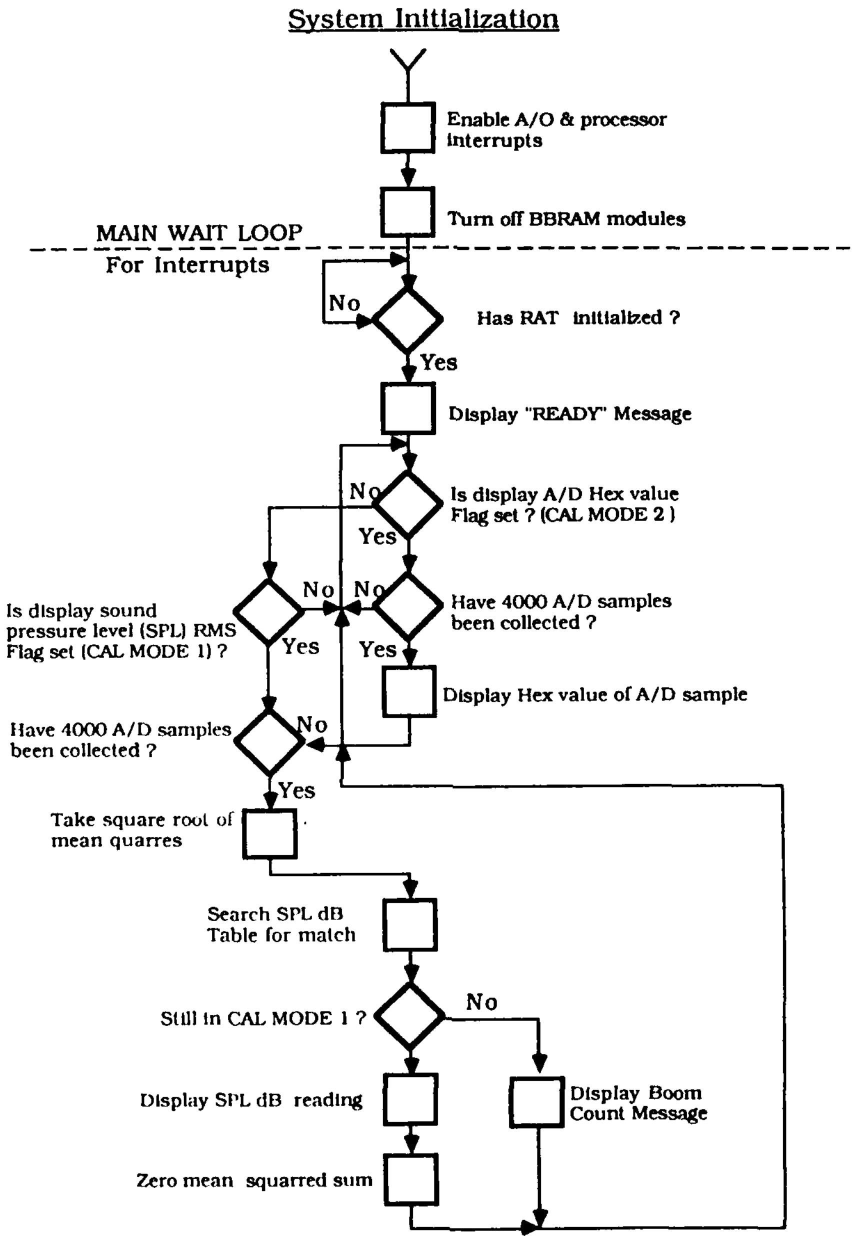
System Initialization
Enable A/O & processor interrupts
Turn off BBRAM modules
MAIN WAIT LOOP
For Interrupts
No
Has RAT initialized ?
Yes
Display "READY" Message
No
Is display A/D Hex value Flag set ? (CAL MODE 2)
Yes
No
No
Is display sound pressure level (SPL) RMS Flag set (CAL MODE 1) ?
Have 4000 A/D samples been collected ?
Yes
Yes
Display Hex value of A/D sample
Have 4000 A/D samples been collected ?
No
Yes
Take square root of mean quarres
Search SPL dB Table for match
Still in CAL MODE 1 ?
No
Display SPL dB reading
Display Boom Count Message
Zero mean squarred sum

Figure 10. BEAR System Initialization Flow Chart (continued)

3.4 Run Routines

A/D INTERRUPT ROUTINE (DAC)

The data acquisition (DAC) routine reads the A/D data on an interrupt. These interrupts occur every 125 microseconds so this routine must process the data quickly. The purpose of DAC is to determine if an event is occurring. If DAC determines an event is not occurring, the data are processed by running average table (RAT) which maintains a running average. If an event is occurring, DAC compares the data with the predetermined parameters, (TRIGGER 2, or TRIGGER 3) to know when to activate the timers. DAC also keeps track of the peak values, positive and negative, during the event. This is performed by the timer interrupt routine (TIMER). All data read during an event are stored in battery RAM in count format.

See Figures 11-13 for A/D Interrupt Flow Chart.

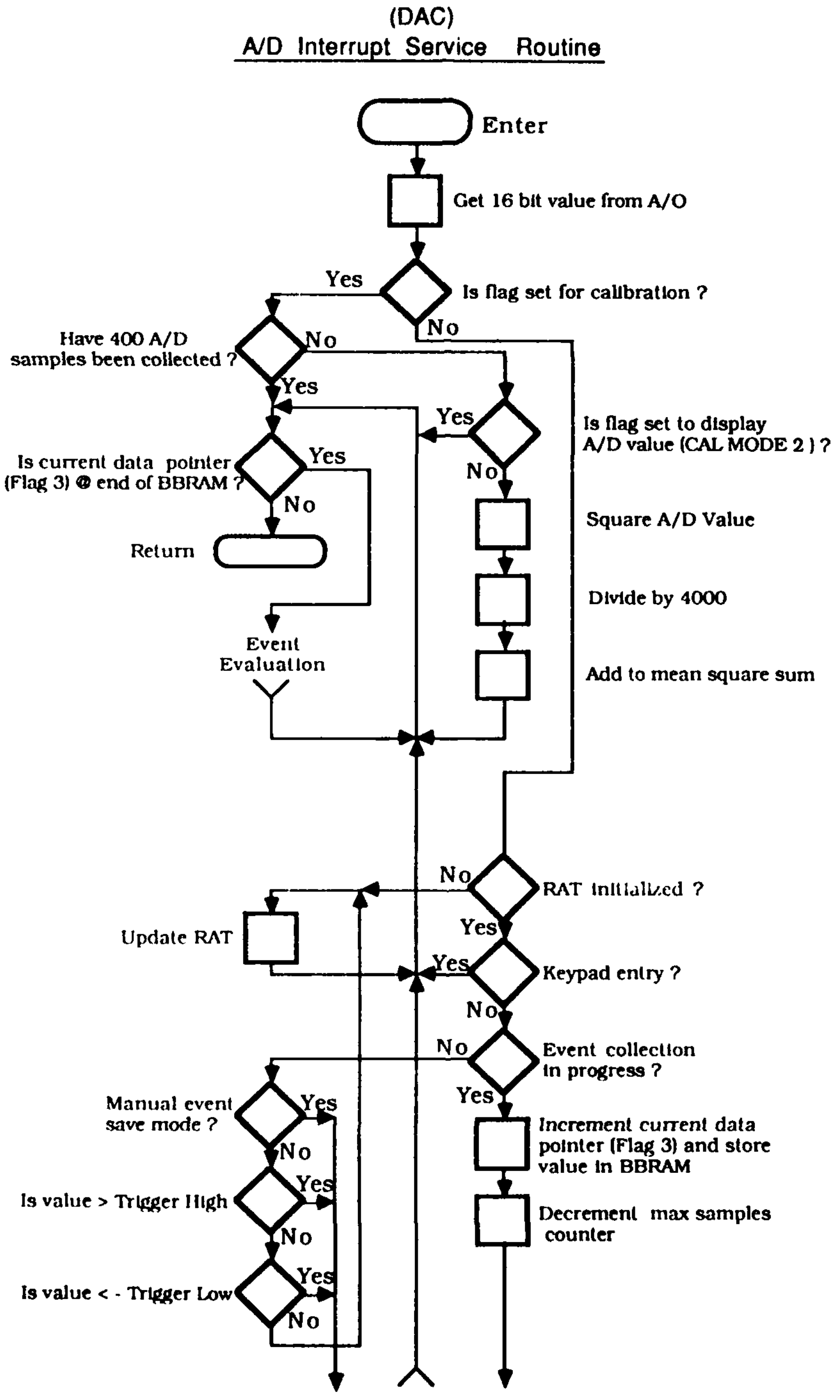
(DAC)
A/D Interrupt Service Routine
Enter
Get 16 bit value from A/O
Yes
Is flag set for calibration ?
No
Have 400 A/D samples been collected ?
No
Yes
Yes
Is flag set to display A/D value (CAL MODE 2) ?
Is current data pointer (Flag 3) @ end of BBRAM ?
Yes
No
No
Square A/D Value
Return
Divide by 4000
Event Evaluation
Add to mean square sum
No
RAT initialized ?
Yes
Update RAT
Yes
Keypad entry ?
No
No
Event collection in progress ?
Manual event save mode ?
Yes
Yes
No
Increment current data pointer (Flag 3) and store value in BBRAM
Yes
Is value > Trigger High
Decrement max samples counter
No
Yes
Is value < - Trigger Low
No

Figure 11. A/D Interrupt Routine Flow Chart

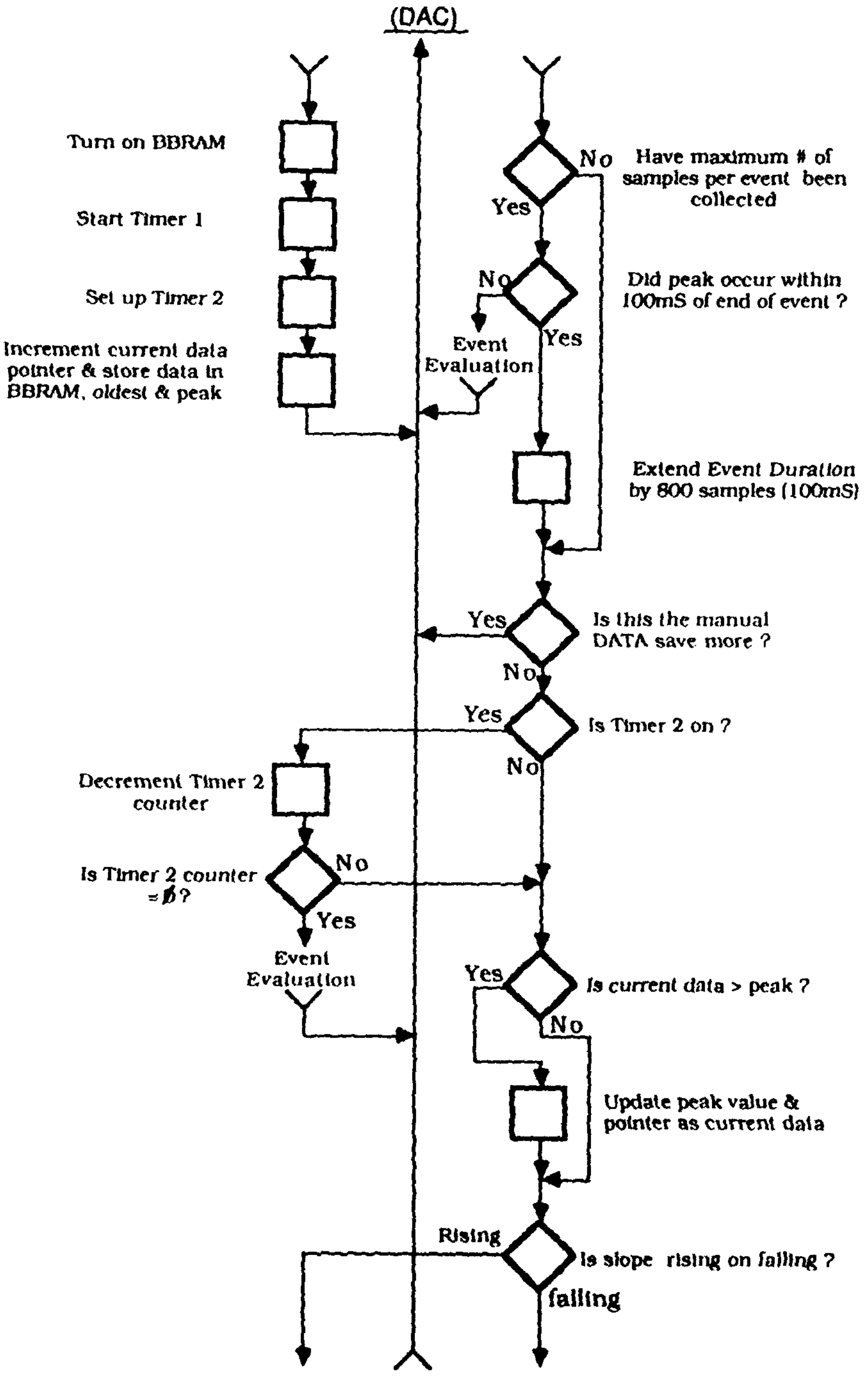
(DAC)
Turn on BBRAM
Start Timer 1
Set up Timer 2
Increment current data pointer & store data in BBRAM, oldest & peak
No
Have maximum # of samples per event been collected
Yes
No
Did peak occur within 100mS of end of event ?
Yes
Event Evaluation
Extend Event Duration by 800 samples (100mS)
Yes
Is this the manual DATA save more ?
No
Yes
Is Timer 2 on ?
No
Decrement Timer 2 counter
Is Timer 2 counter =0?
No
Yes
Event Evaluation
Yes
Is current data > peak ?
No
Update peak value & pointer as current data
Rising
Is slope rising on falling ?
falling

Figure 12. A/D Interrupt Routine Flow Chart (continued)

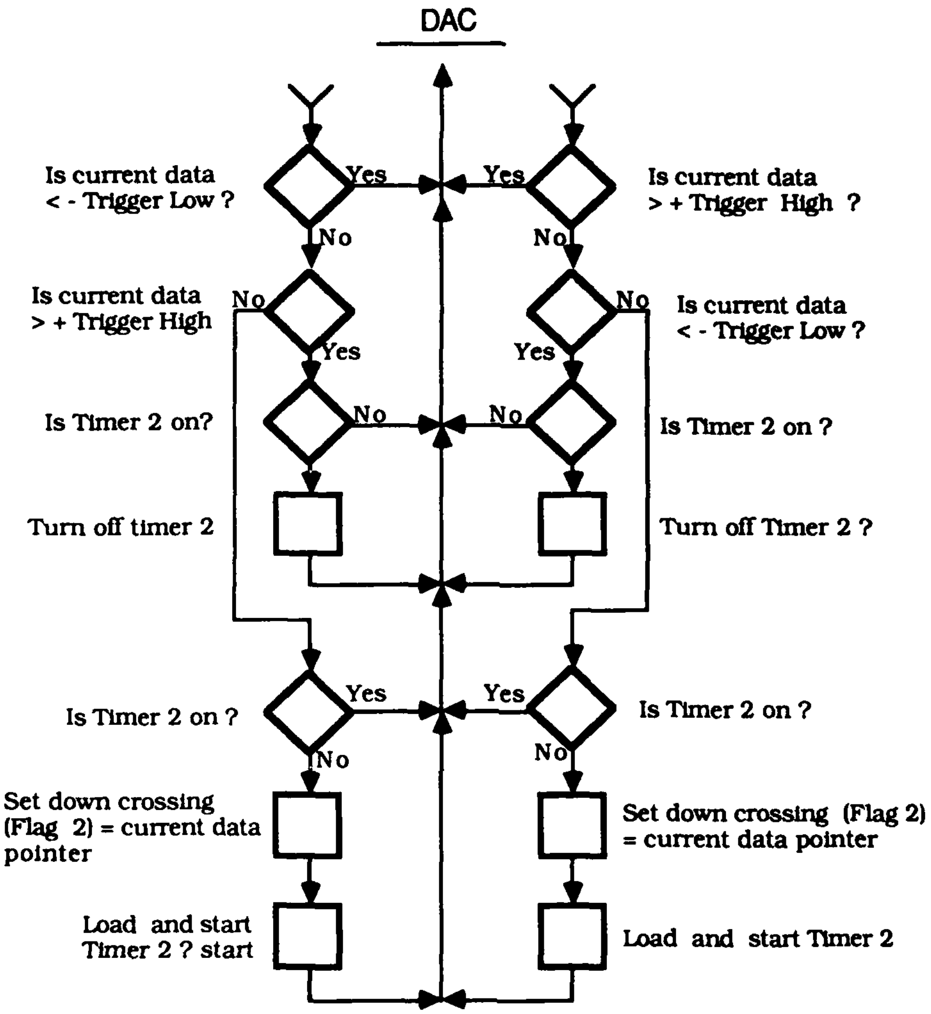

Figure 13. A/D Interrupt Routine Flow Chart (continued)

RUNNING AVERAGE TABLE (RAT)

During the power-up diagnostics, the battery RAM modules are checked and each location is set to zero. Since there can be a variable number of modules implemented, the end of RAM is determined and that address is saved in ENDRAT. The beginning of the average table is calculated by using the address ENDRAT-16,384. This sets the Running Average Table for 2 seconds. The address of the beginning of the table is maintained in register A5 and the latest table pointer in A6. The running average is maintained in register D3 with the moving sum in D4. The average is stored with each valid boom event to determine any prior offset or microphone drift.

See Figure 14 for Running Average Table Flow Chart.

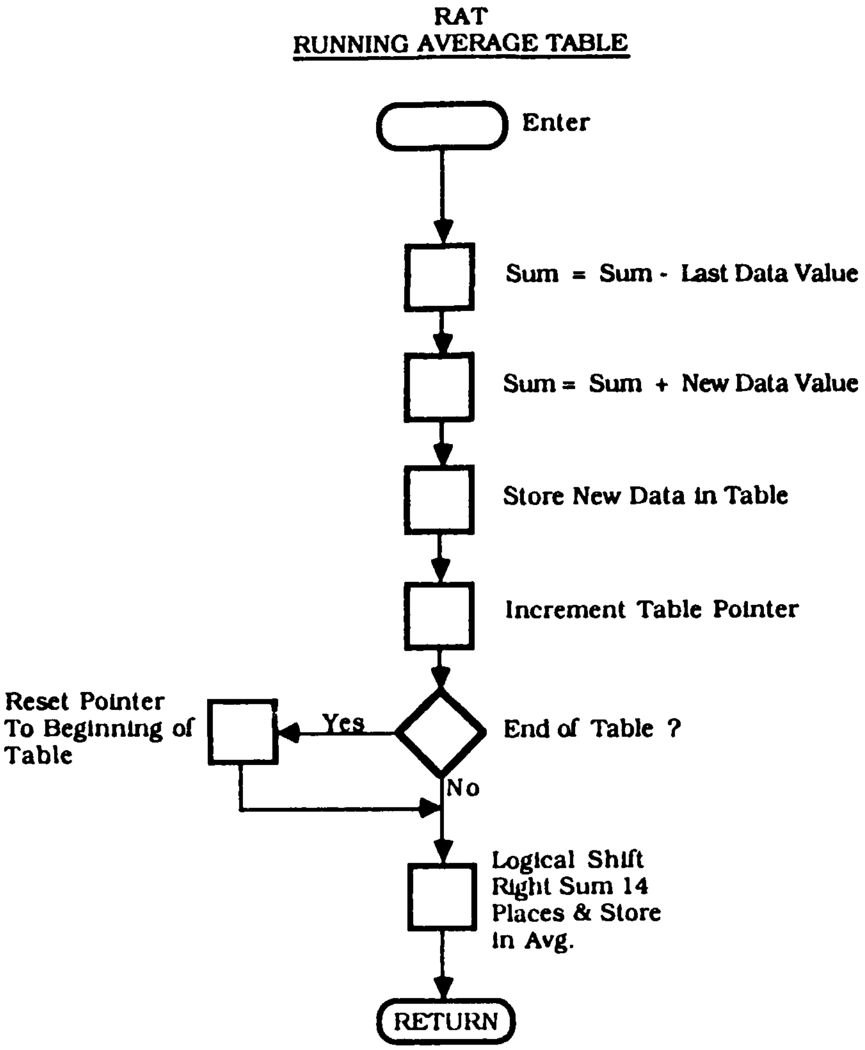
RAT
RUNNING AVERAGE TABLE
Enter
Sum = Sum - Last Data Value
Sum = Sum + New Data Value
Store New Data in Table
Increment Table Pointer
End of Table ?
Yes
Reset Pointer To Beginning of Table
No
Logical Shift Right Sum 14 Places & Store in Avg.
RETURN

Figure 14. Running Average Table Flow Chart

TIMER INTERRUPT ROUTINE (TIMER)

The TIMER routine services the timer interrupt which is used to trigger an end of an event. There are two timers which can generate an interrupt: Timer 1 which is started at the beginning of an event and Timer 2 which is started at a down crossing point (see Figure 6). Once the interrupt occurs, TIMER analyzes the data to determine if the event was a sonic boom. There are several parameters that are checked to validate the event. They are:

- Sufficient Peak Value
- Data Maintained a Positive an Negative Pulse times after the Peaks.
- Peak Slope Was Fast Enough

If the event was valid, the time, date, and average is stored after the data followed by three barker codes. If the event was invalid, TIMER resets the data pointers to the beginning of the event and the next event is recorded over the top of the invalid event. Finally, the event counter is incriminated and the updated "YES/NO" message is displayed. Before exiting the timer routine, the system parameters and data pointer are saved in battery RAM.

See Figure 15 for Timer Interrupt Flow Chart.
See Figures 16-21 for Event Evaluation Flow Charts.

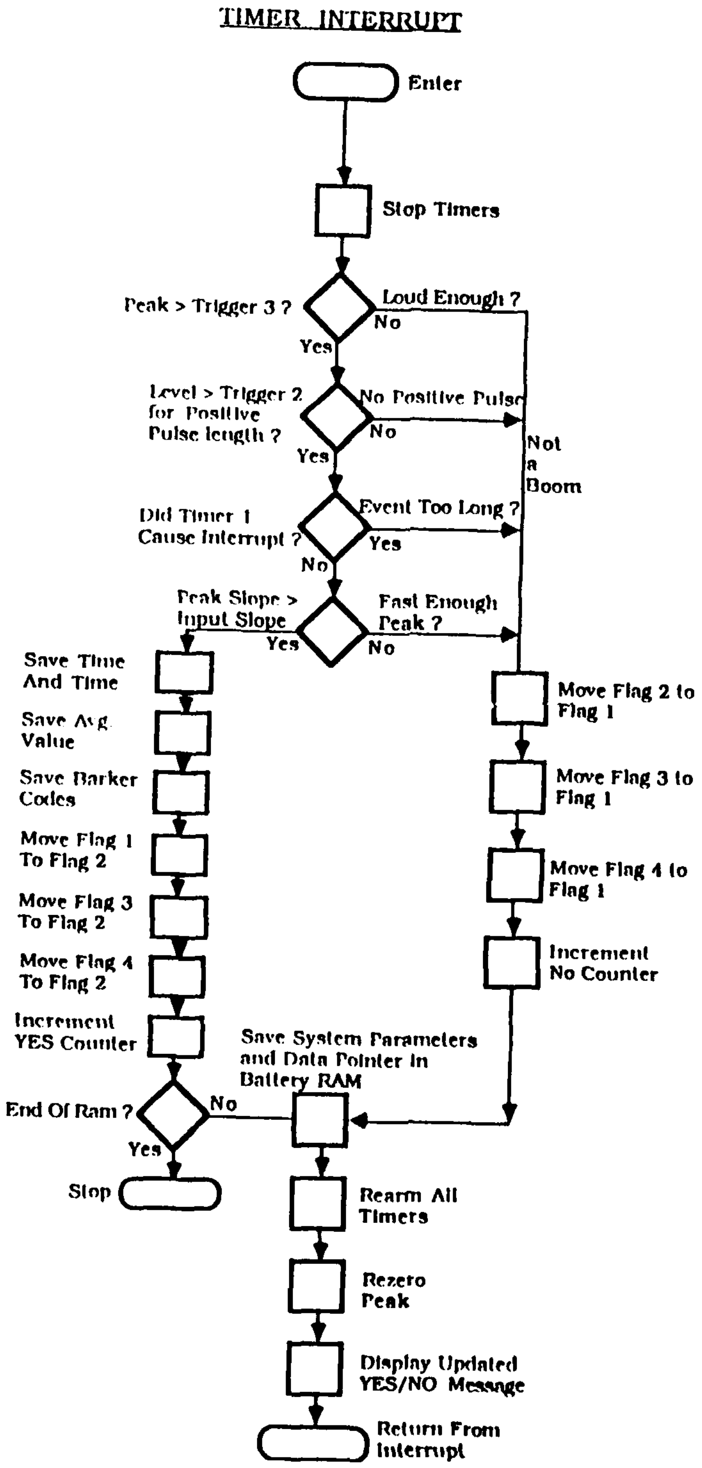

Figure 15. A/D Interrupt Routine Flow Chart

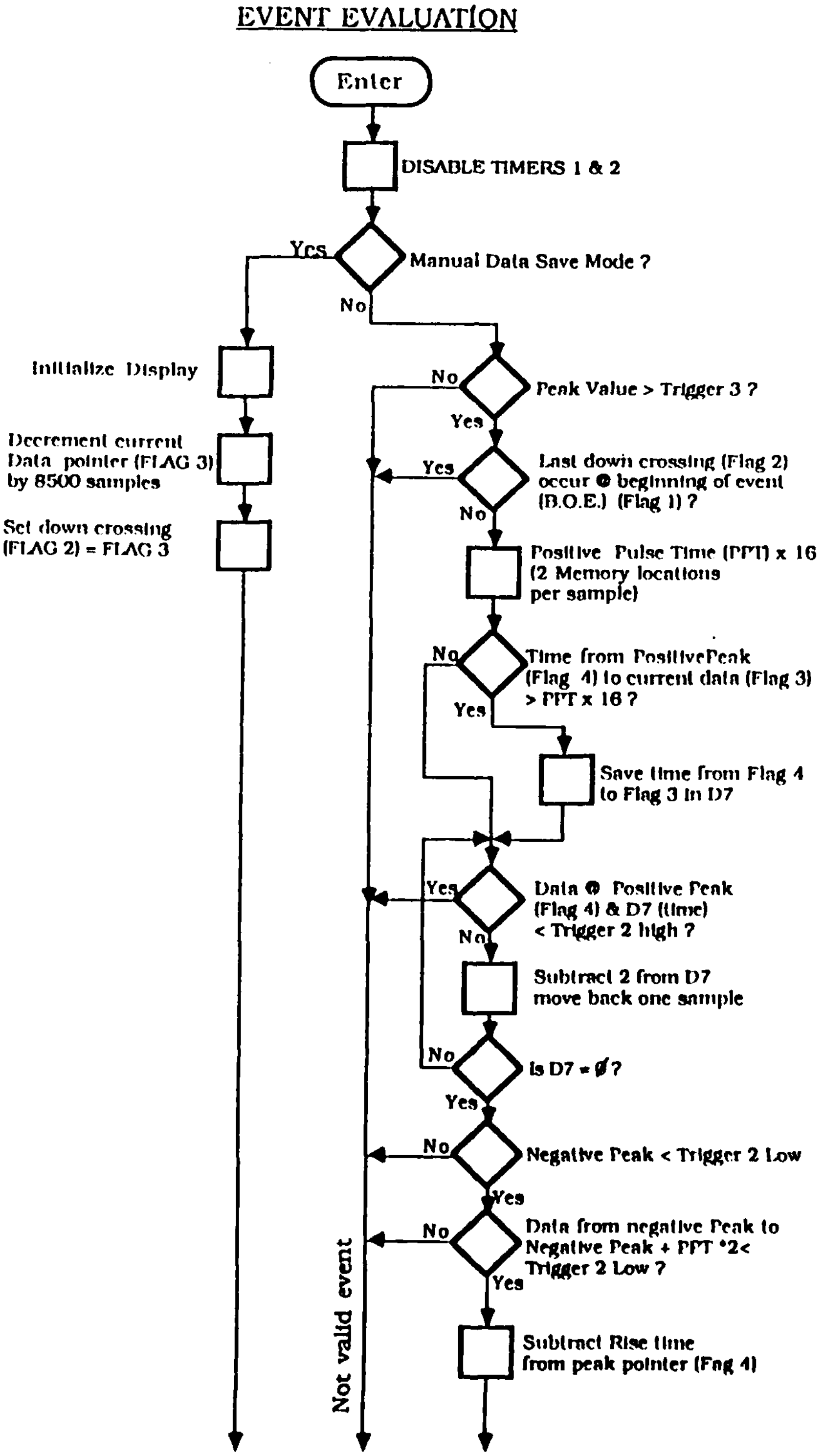
EVENT EVALUATION
Enter
DISABLE TIMERS 1 & 2
Yes
Manual Data Save Mode ?
No
Initialize Display
Decrement current Data pointer (FLAG 3) by 8500 samples
Set down crossing (FLAG 2) = FLAG 3
No
Peak Value > Trigger 3 ?
Yes
Yes
Last down crossing (Flag 2) occur @ beginning of event (B.O.E.) (Flag 1) ?
No
Positive Pulse Time (PPT) x 16 (2 Memory locations per sample)
No
Time from PositivePeak (Flag 4) to current data (Flag 3) > PPT x 16 ?
Yes
Save time from Flag 4 to Flag 3 in D7
Yes
Data @ Positive Peak (Flag 4) & D7 (time) < Trigger 2 high ?
No
Subtract 2 from D7 move back one sample
No
Is D7 = Ø ?
Yes
No
Negative Peak < Trigger 2 Low
Yes
No
Data from negative Peak to Negative Peak + PPT *2< Trigger 2 Low ?
Yes
Subtract Rise time from peak pointer (Fag 4)
Not valid event

Figure 16. Event Evaluation Flow Chart

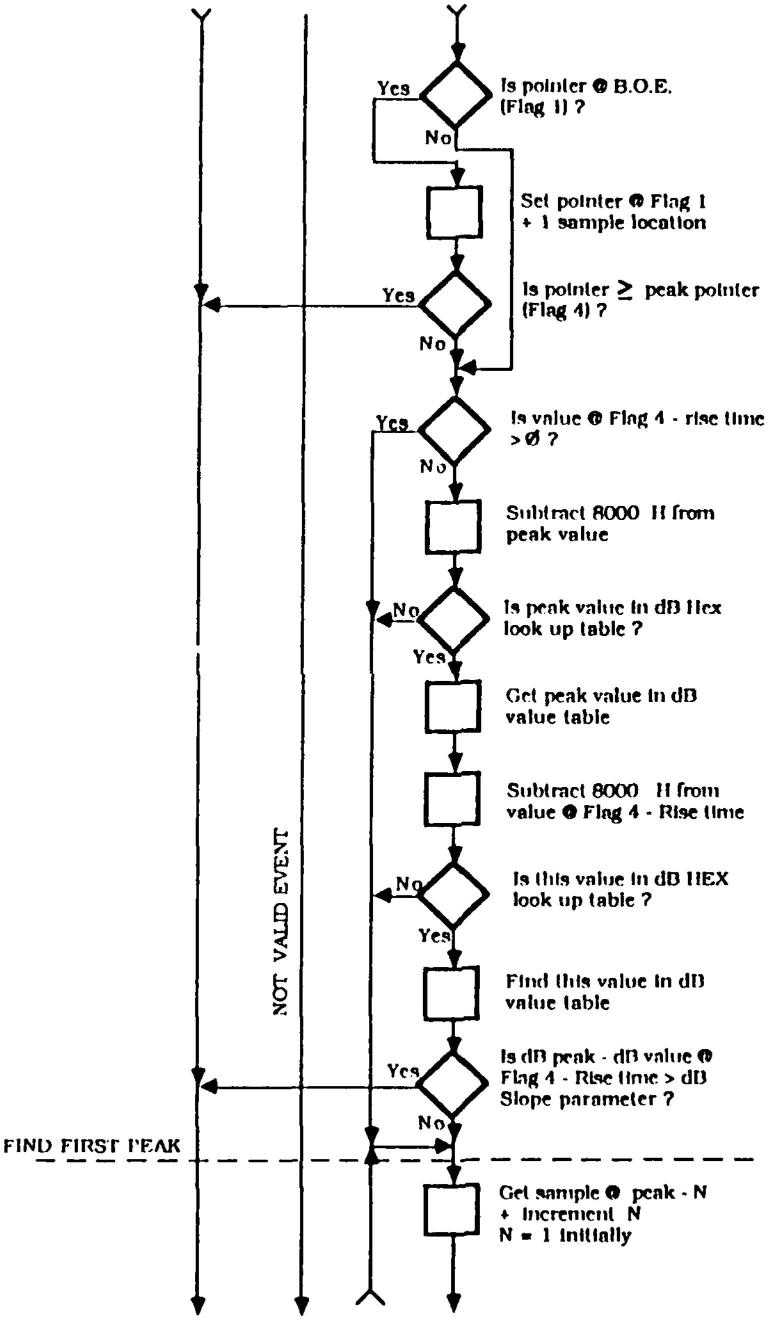

Figure 17. Event Evaluation Flow Chart (continued)

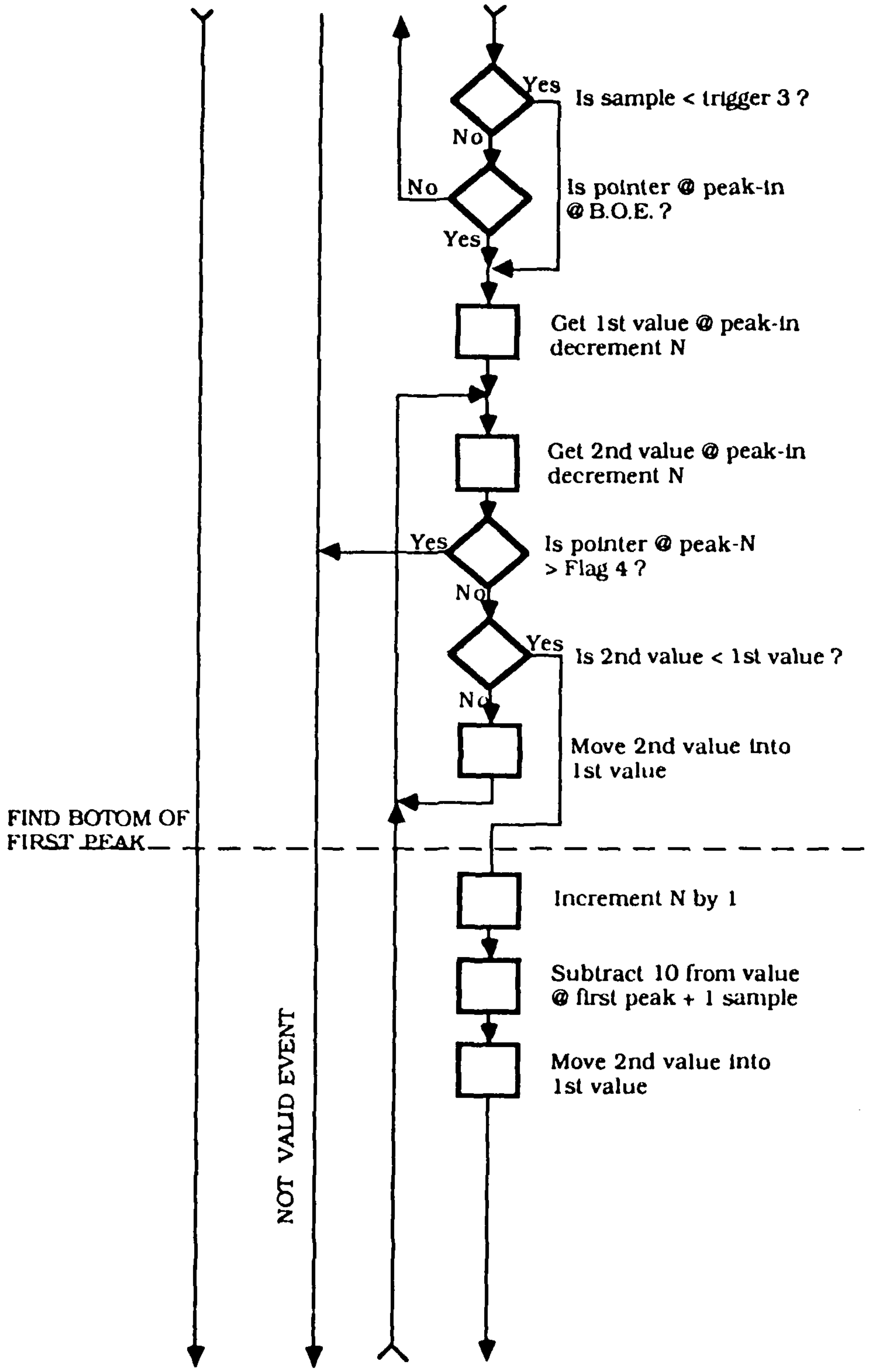

Figure 18. Event Evaluation Flow Chart (continued)

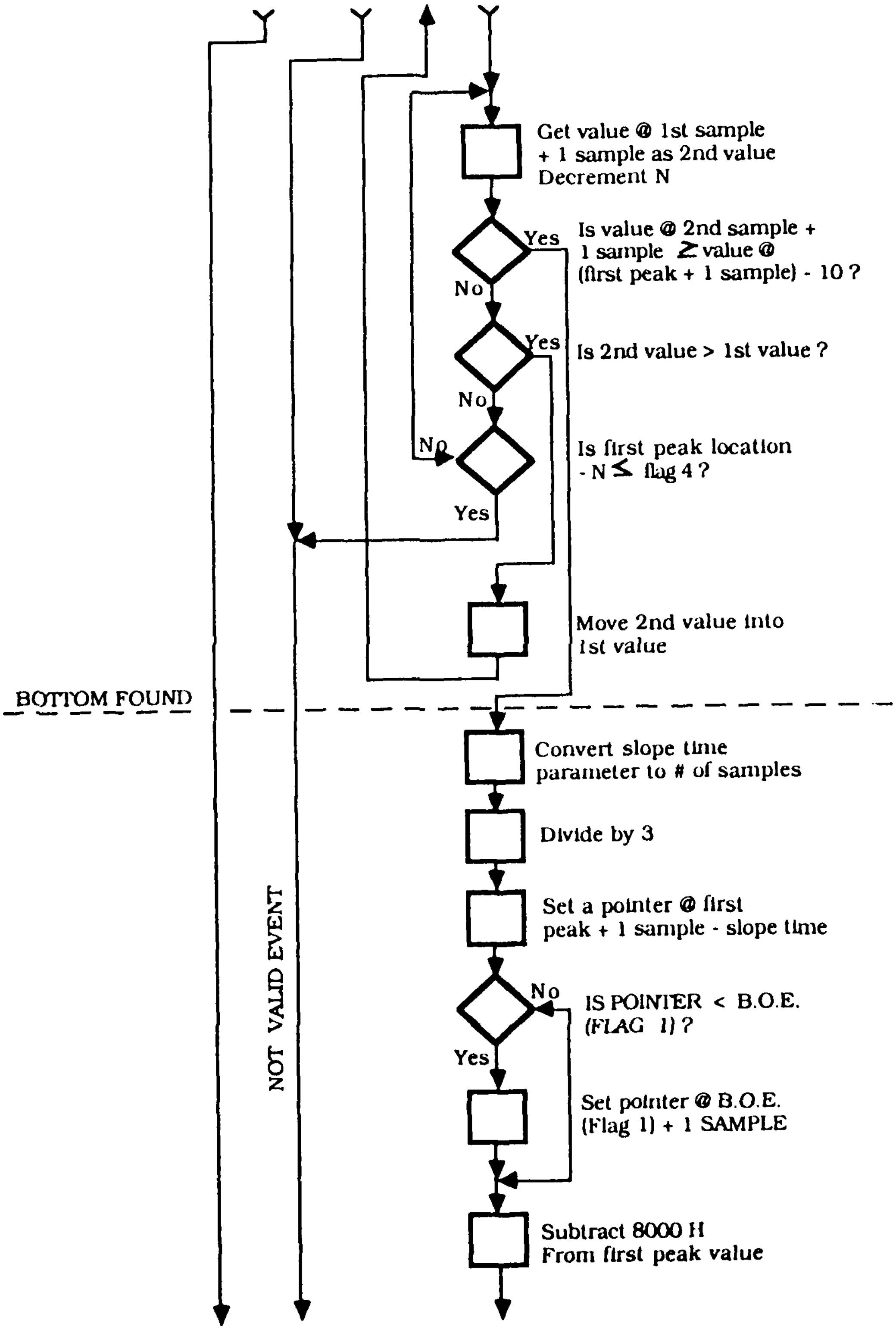

Figure 19. Event Evaluation Flow Chart (continued)

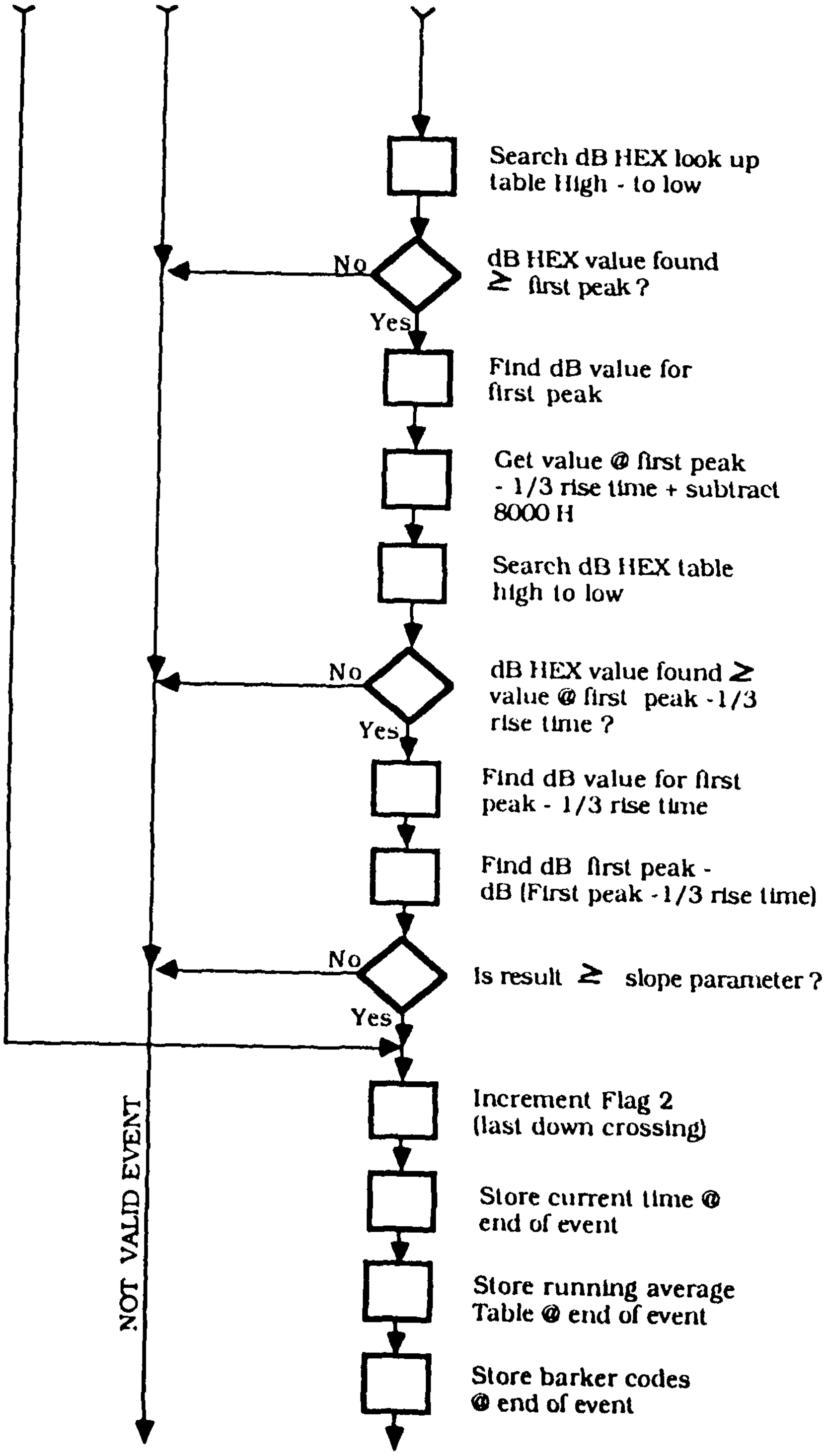
Search dB HEX look up table High - to low
No
dB HEX value found ≥ first peak ?
Yes
Find dB value for first peak
Get value @ first peak - 1/3 rise time + subtract 8000 H
Search dB HEX table high to low
No
dB HEX value found ≥ value @ first peak -1/3 rise time ?
Yes
Find dB value for first peak - 1/3 rise time
Find dB first peak - dB (First peak -1/3 rise time)
No
Is result ≥ slope parameter ?
Yes
Increment Flag 2 (last down crossing)
Store current time @ end of event
Store running average Table @ end of event
Store barker codes @ end of event
NOT VALID EVENT

Figure 20. Event Evaluation Flow Chart (continued)

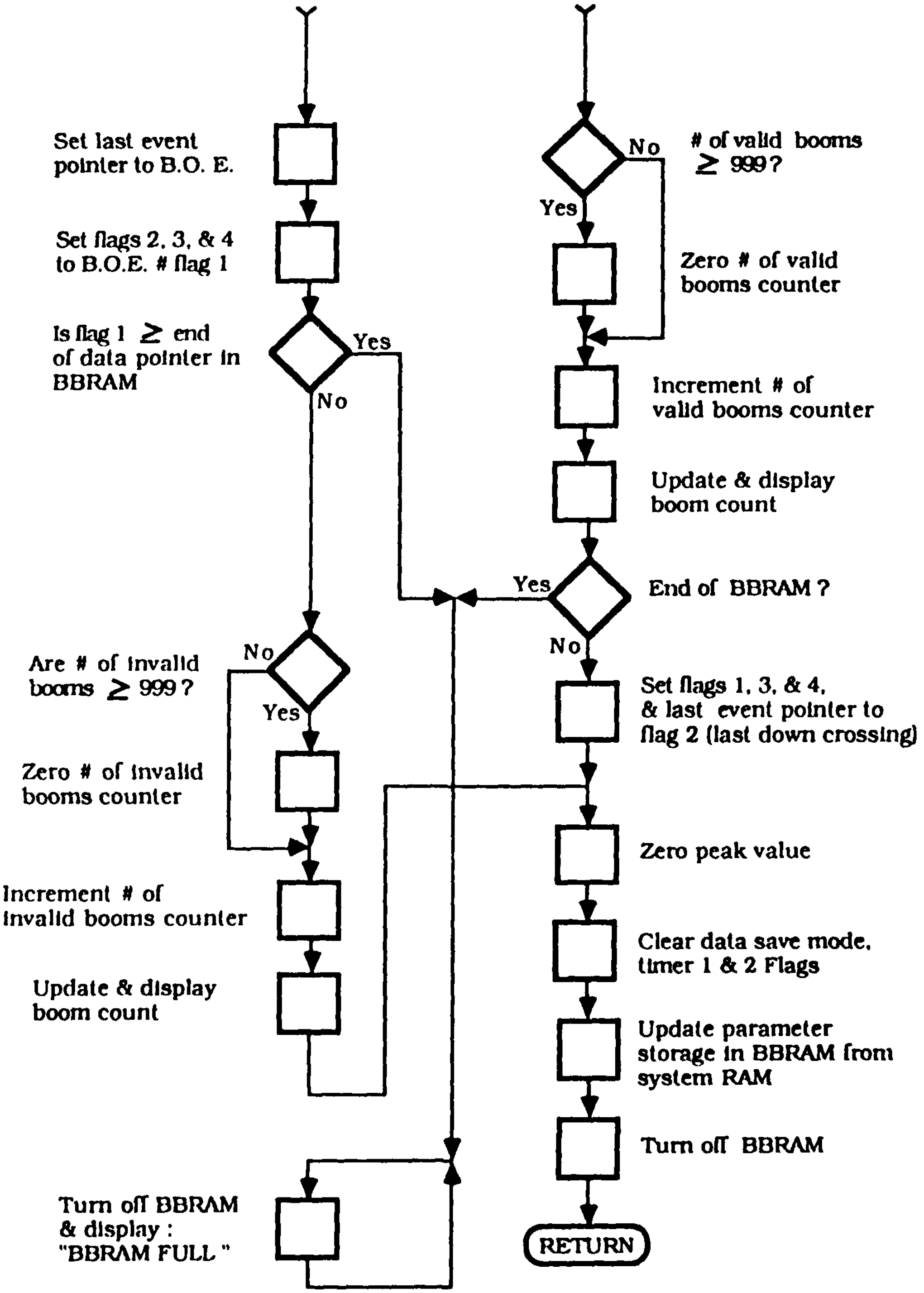
Set last event pointer to B.O. E.
Set flags 2, 3, & 4 to B.O.E. # flag 1
Is flag 1 ≥ end of data pointer in BBRAM
Yes
No
Are # of invalid booms ≥ 999 ?
No
Yes
Zero # of invalid booms counter
Increment # of invalid booms counter
Update & display boom count
Turn off BBRAM & display : "BBRAM FULL "
# of valid booms ≥ 999 ?
No
Yes
Zero # of valid booms counter
Increment # of valid booms counter
Update & display boom count
End of BBRAM ?
Yes
No
Set flags 1, 3, & 4, & last event pointer to flag 2 (last down crossing)
Zero peak value
Clear data save mode, timer 1 & 2 Flags
Update parameter storage in BBRAM from system RAM
Turn off BBRAM
RETURN

Figure 21. Event Evaluation Flow Chart (continued)

KEY PAD INTERRUPT ROUTINE (KEYPAD)

The KEY PAD routine services the interrupt generated by a key pad entry. It interprets the key by calling GETKEY and processes the function that is requested. The functions available on the BEAR are:

Function Code	Description
A	Set time and date.
B	Set ID and timer values (Test No., Site No., Serial No., Timer 1, and Timer 2).
C	Set calibration.
D	Set soft values: (Trigger 3, Trigger 2, Positive Pulse Time, risetime dB, and risetime).
E	Display Memory Remaining
F	Save Data

Once the function code is entered, KEY PAD determines if the values entered are valid. If an incorrect value is entered, an error message is displayed. The KEY PAD routine outputs the entered data to the display to provide operator feedback. Once the last entry is made, the system parameters are updated with the new values and a change message is formulated and stored in battery RAM as well as a copy of all the systems parameters. Once the display is turned on by entering "*," data acquisition is bypassed to prevent data analysis being performed with invalid parameters.

See Figure 22 for Keypad Interrupt Flow Chart.
See Figure 23 for GETKEY Flow Chart.
See Figure 24 for A Function routine Flow Chart.
See Figure 25 for B Function routine Flow Chart.
See Figure 26 for C Function routine Flow Chart.
See Figure 27 for D Function routine Flow Chart.

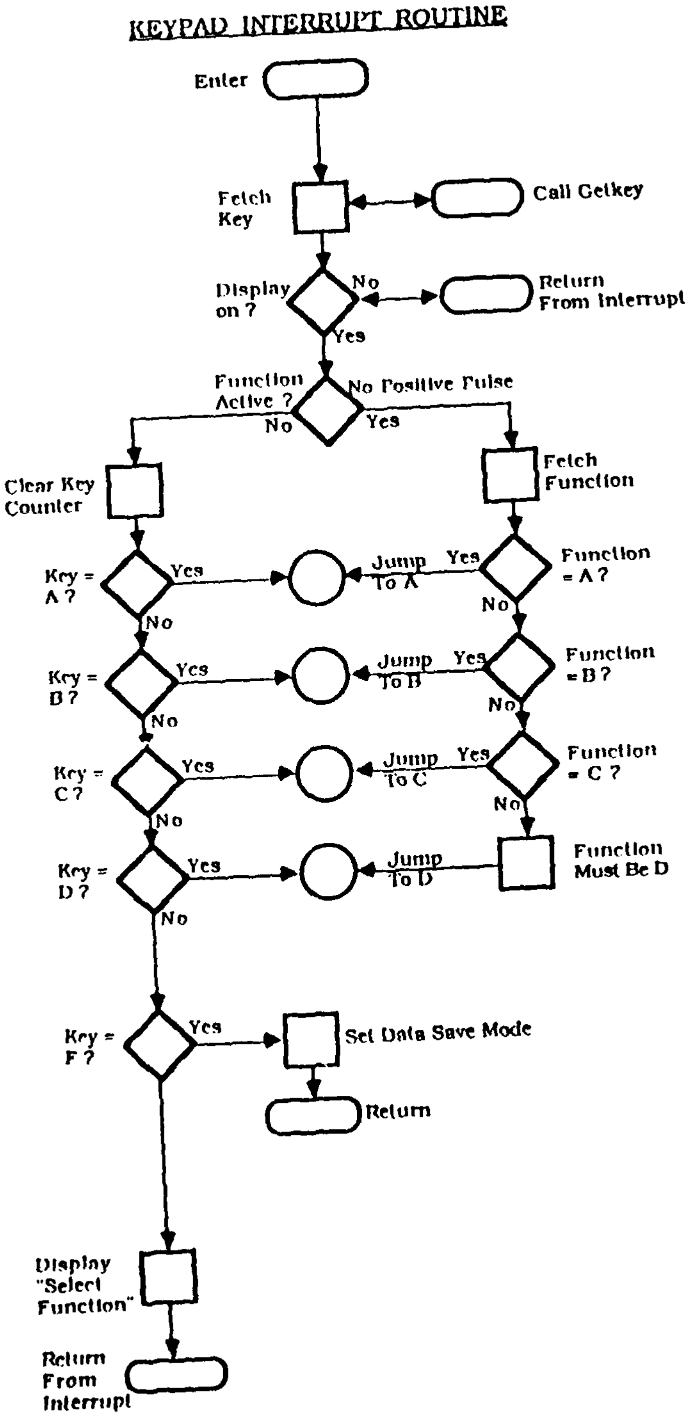

Figure 22 KEYPAD Interrupt Flow Chart

GETKEY - PARSE KEYPAD INPUT

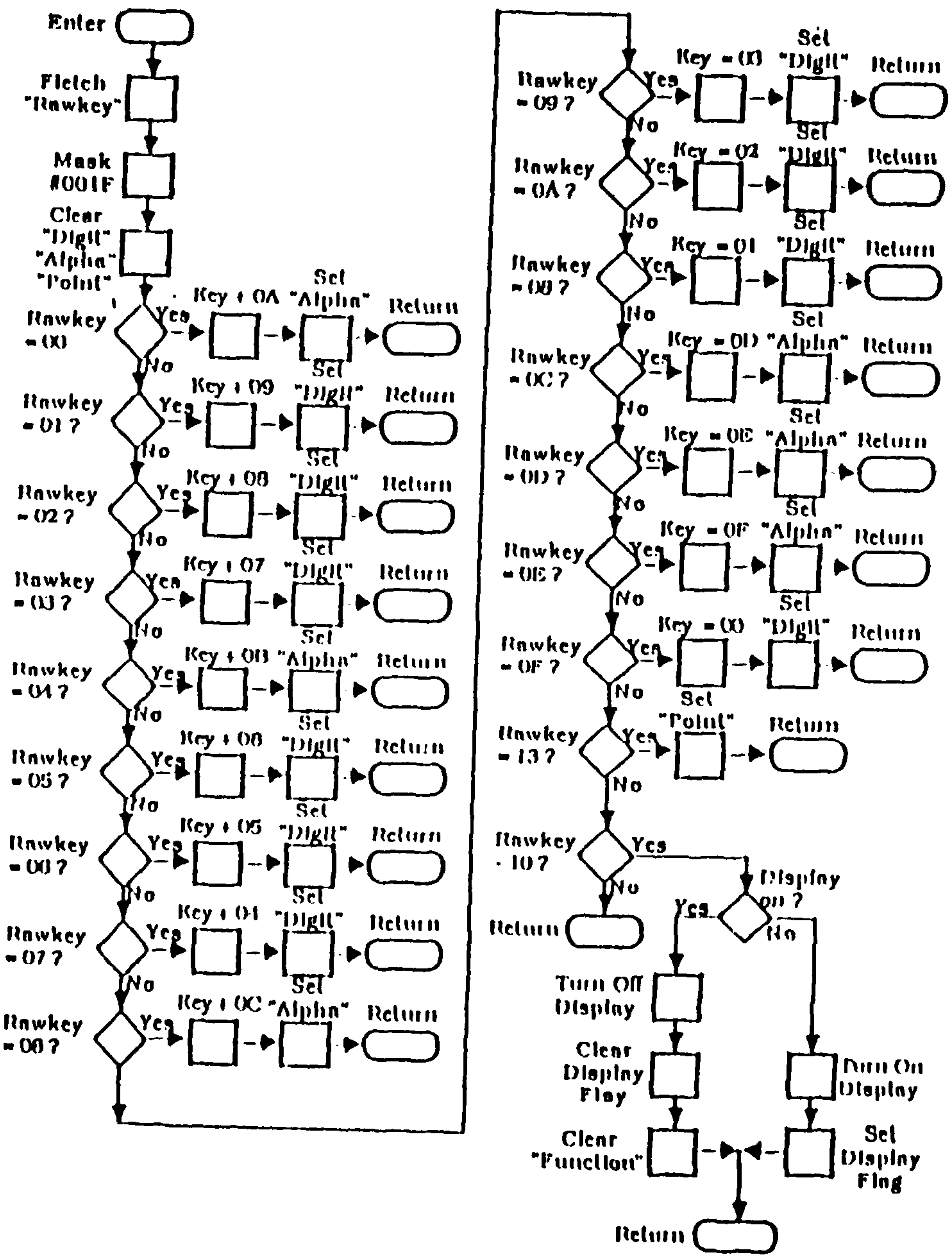

Figure 23. GETKEY Flow Chart

"A" FUNCTION ROUTINE

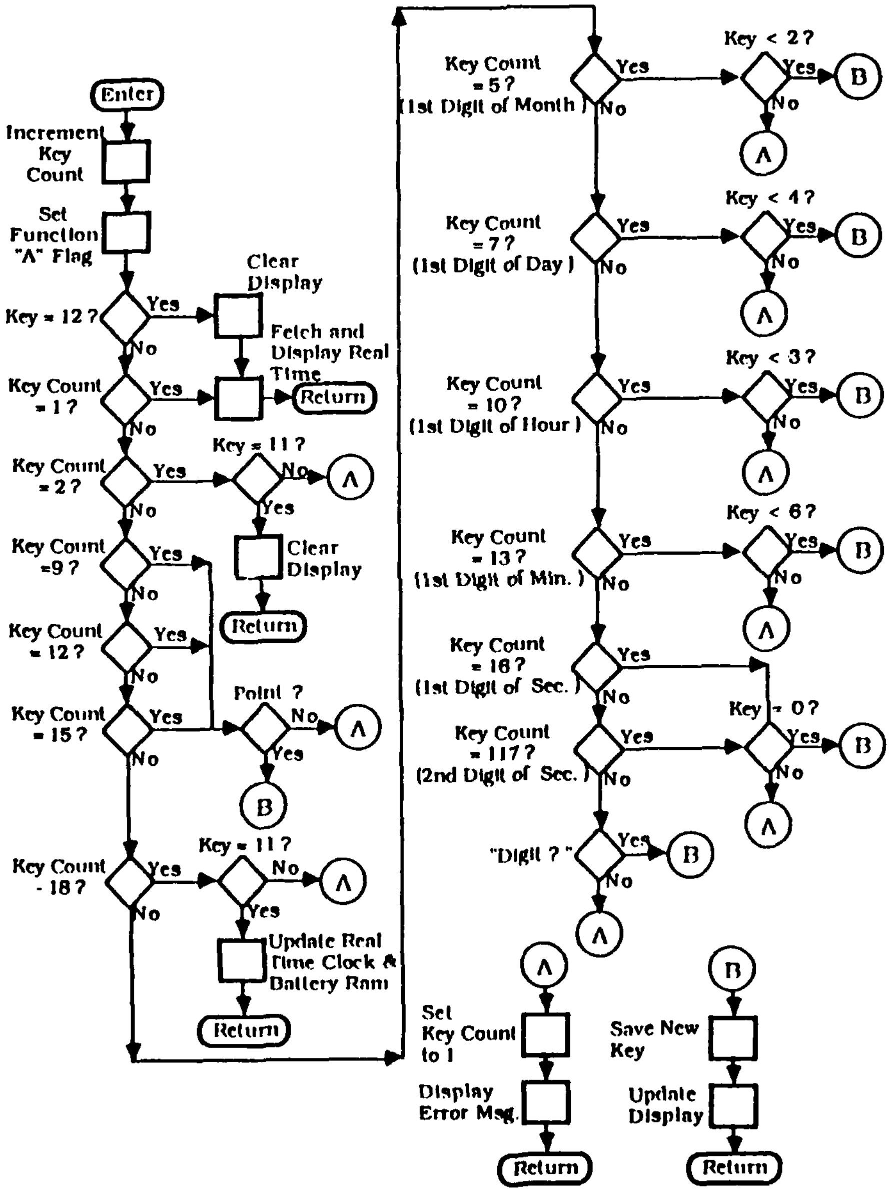

Figure 24. A Function Routine Flow Chart

"B" FUNCTION ROUTINE

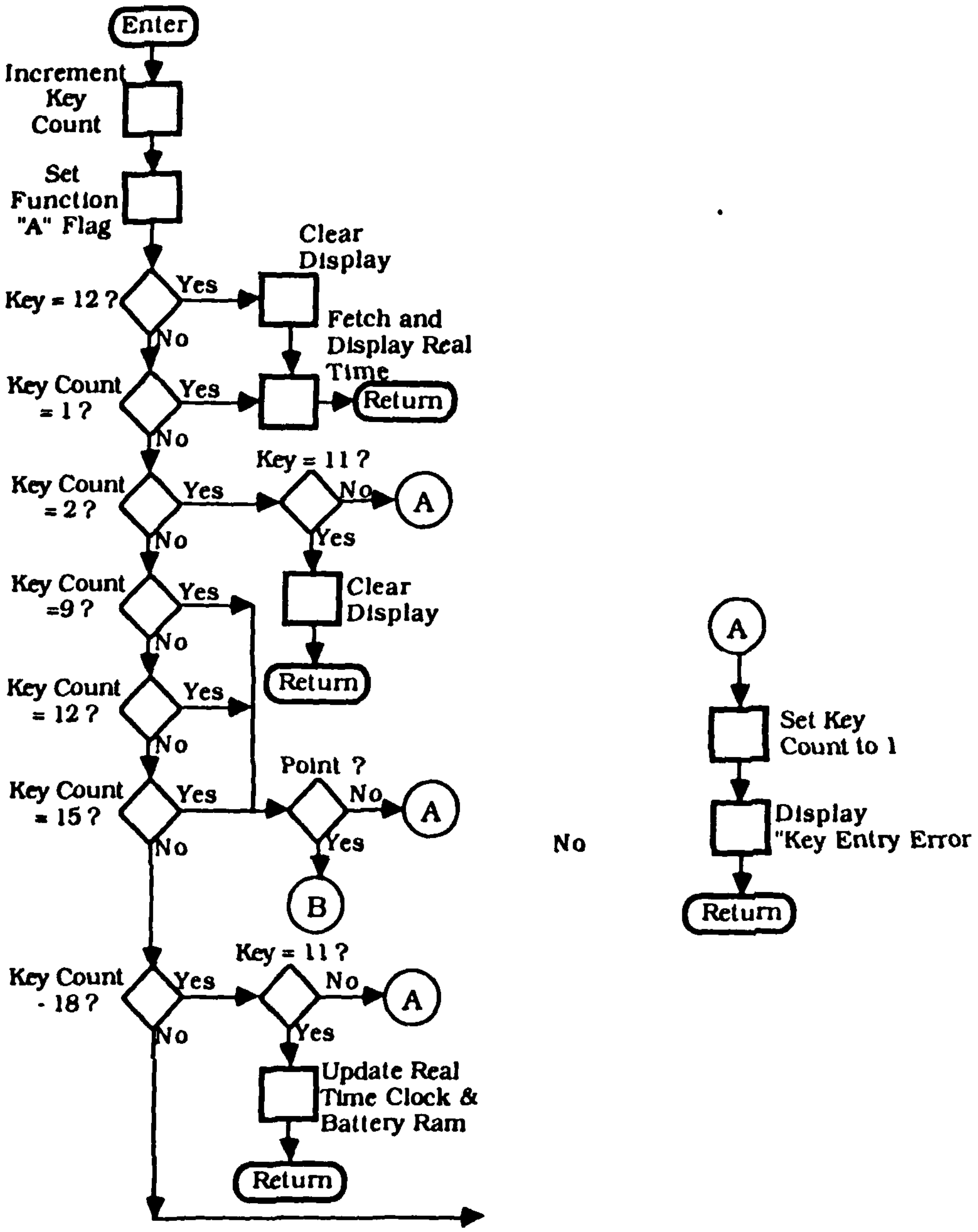

Figure 25. B Function Routine Flow Chart

"C" FUNCTION ROUTINE

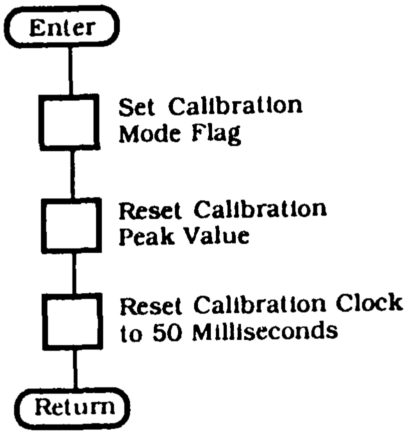
Enter
Set Calibration Mode Flag
Reset Calibration Peak Value
Reset Calibration Clock to 50 Milliseconds
Return

Figure 26. C Function Routine Flow Chart

"D" FUNCTION ROUTINE

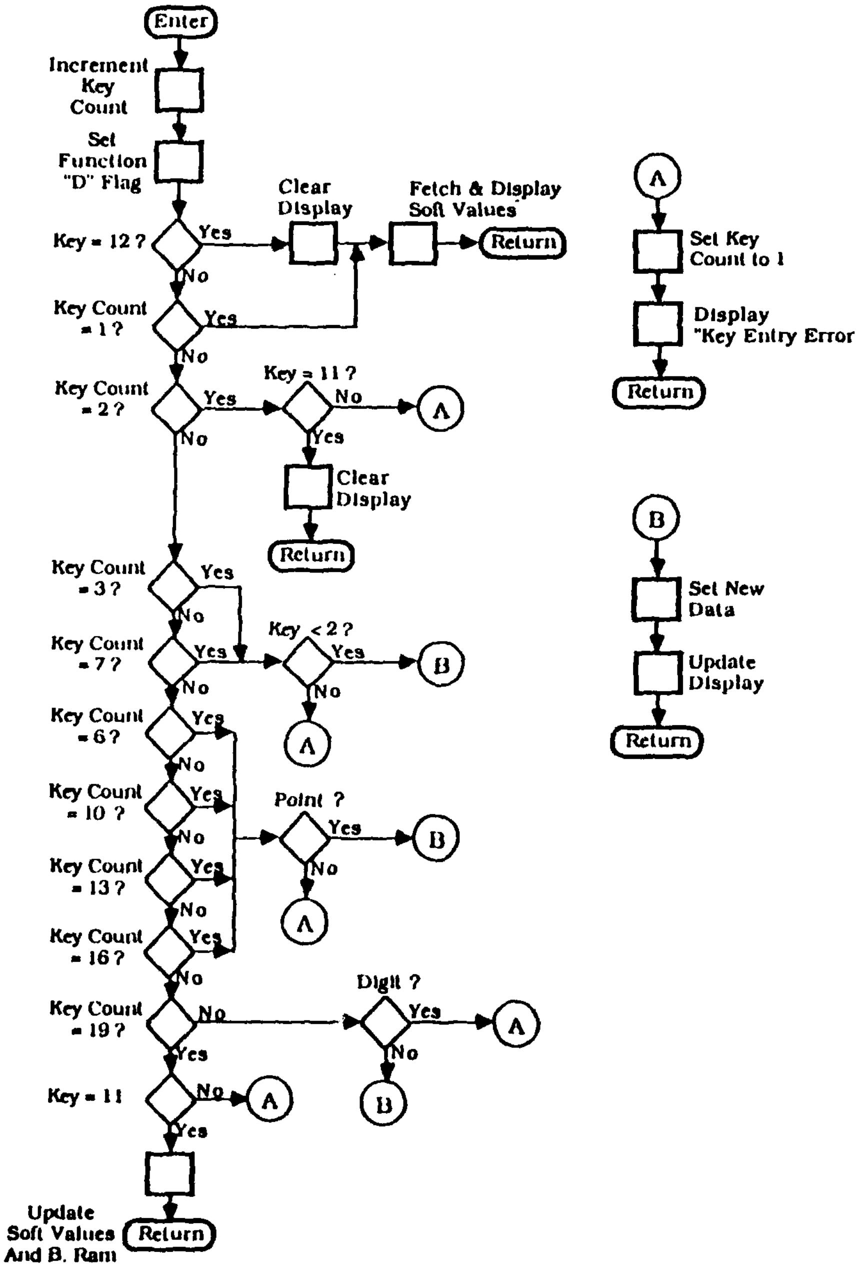

Figure 27. D Function Routine Flow Chart

3.5 Stored data examples

INITIALIZATION DATA

The following example illustrates some typical data formats from different types of events occurring in the BEAR. These represent the data as it is stored on the RAM modules and transferred to the raw data files.

The first event to occur following application of power to the BEAR is the initialization diagnostics. Following their successful completion, the working cache SRAM is loaded with the default working parameters. Then the following data set is loaded into the first RAM module pair (least significant address shown first). These values represent the default parameters. EB and 90 are the data values we chose to be our barker code used to separate events in the RAM storage. Please note that only on the very first writing of barker codes is a set of five data values of EB90 written. All other events, be they sonic boom or keypad events, are always separated by a set of three barker codes , which are always preceded by a three word group of data representing the current real-time. All of the programable parameters are set off with a mask of 1000_{16} to 9000_{16}. If the parameters are too big to fit into the mask then they are written in the next word after the mask. The data values are obtained by subtracting the mask value from the stored value.

HEX VALUE	MSB	LSB	DESCRIPTION
EB90	11101011_2	10010000_2	barker Code
EB90	11101011_2	10010000_2	barker Code
EB90	11101011_2	10010000_2	barker Code
EB90	11101011_2	10010000_2	barker Code
EB90	11101011_2	10010000_2	barker Code
1000	00010000_2	00000000_2	Test Number Default = 00_{10} With mask of 1000_{16}
2000	00100000_2	00000000_2	Site Number Default = 00_{10} With mask of 2000_{16}
3000	00110000_2	00000000_2	BEAR Serial Number Default = 00_{10} With mask of 3000_{16}
4000	01000000_2	00000000_2	Mask Word for Timer #1 The next word contains the Timer #1 count value divided by 10_{16}. 1 count = 1/8000 Second
03E8	00000011_2	11101000_2	Timer #1 Default Value of 1000_{10} (This is the value stored for a 2 Second Timer 1)

		(1000_{10} * 10_{16} = 16000_{10} counts = 2 sec event timer)
5000	01010000_2 00000000_2	Mask Word for Timer #2 The next word contains the Timer #2 count value divided by 10_{16}
03E8	00000011_2 11101000_2	Timer #2 Default Value of 1000_{10} (This is the value stored for a .2 Second Timer 2) (1000_{10} * 10_{16} = 16000_{10} counts = 2 sec; interperted by program as .2 sec cycle timer)
600A	01100000_2 00001010_2	Positive Pulse Default Value = 10_{10} With mask of 6000_{16}
7000	01110000_2 00000000_2	Mask Word for Trigger #2 The next word contains the Trigger #2 count value

8012	10000000_2 00010010_2	Trigger #2 Default of
		count = 18_{10}
		Value = 100 dB

8000	10000000_2 00000000_2	Mask Word for Trigger #3 The next word contains the Trigger #3 value

0040	00000000_2 01000000_2	Trigger #3 Default Value
		count = 64_{10}
		Value = 107dB

9006	10010000_2 00000110_2	Peak Slope Rise dB Default = 6 With mask of 9000_{16}
9035	10010000_2 00110101_2	Peak Slope Risetime Default = 35 With mask of 9000_{16}
0000	00000000_2 00000000_2	Default: Minutes and Seconds (2 words Min 00 - Sec 00)
2000	00100000_2 00000000_2	Default: Days and Hours (2 words Day 20 - Hr 00)
8805	10001000_2 00000101_2	Default: Years and Months (2 words Yr 88 - Mn May)
EB90	11101011_2 10010000_2	barker Code
EB90	11101011_2 10010000_2	barker Code
EB90	11101011_2 10010000_2	barker Code

PARAMETER CHANGE DATA

When any parameter is changed it is stored in the Battery Ram just like any other data. It is distinguished from real Boom data or stored data by its length. Any event less than 10 data points is considered a parameter change. To change any parameter like trigger #3, or any "D" key value, all "D" key parameters must be entered, not just those to be changed. For example, if the "D" key parameters were set at 105.095.00.05.02 and you wanted to change the value of trigger #3 (high trigger) to 137 dB, press * the ENT and enter the new value 137.095.00.05.02 and press ENT. This procedure applies to "A" and "B" keys also. Keys C, E, and F are not for data entry. The "F" key allows storage of 1 second of data, or 7661 data points. To save data, press * and then F.

The following is an example of a time change on the "A" key.

HEX VALUE	MSB	LSB	DESCRIPTION
EB90	11101011_2	10010000_2	barker Code
EB90	11101011_2	10010000_2	barker Code
EB90	11101011_2	10010000_2	barker Code
			(These three are the previous event's ending barker Code, not to be rewritten)
3700	00100101_2	00000000_2	Real-Time: Minutes and Seconds
2313	00100011_2	00010011_2	Real-Time: Days and Hours
8908	10001001_2	00001000_2	Real-Time: Years and Months
EB90	11101011_2	10010000_2	barker Code
EB90	11101011_2	10010000_2	barker Code
EB90	11101011_2	10010000_2	barker Code

The following is an example of a site, test and serial number change on the "B" key.

HEX VALUE	MSB	LSB	DESCRIPTION
EB90	11101011_2	20020000_2	barker Code
EB90	11101011_2	10010000_2	barker Code
EB90	11101011_2	10010000_2	barker Code
			(These three are the previous event's ending barker Code, not to be rewritten)
1001	00010000_2	00000001_2	Test Number changed to 01_{10}

		With mask of 1000_{16}
2002	00100000_2 00000010_2	Site Number changed to 02_{10} With mask of 2000_{16}
37D7	00110111_2 11010111_2	BEAR Serial Number changed to 2007_{10} With mask of 3000_{16}
4000	01000000_2 00000000_2	Mask Word for Timer #1 The next word contains the Timer #1 count value divided by 10_{16} 1 count = 1/8000 Second
03E8	00000011_2 11101000_2	Timer #1 left at Value of 1000_{10} (This is the value stored for a 2 Second Timer 1) (1000_{10} * 10_{16} = 16000_{10} counts = 2 sec event timer)
5000	01010000_2 00000000_2	Mask Word for Timer #2 The next word contains the Timer #2 count value divided by 10_{16}
09C4	00001001_2 11000100_2	Timer #2 changed to Value of 2500_{10} (This is the value stored for a .5 Second Timer 2) (2500_{10} * 10_{16} = 40000_{10} counts = 5 sec; interperted by program as .5 sec cycle timer)
3705	00100101_2 00000101_2	Real-Time: Minutes and Seconds
2315	00100011_2 00010101_2	Real-Time: Days and Hours
8908	10001001_2 00001000_2	Real-Time: Years and Months
EB90	11101011_2 10010000_2	barker Code
EB90	11101011_2 10010000_2	barker Code
EB90	11101011_2 10010000_2	barker Code

EVENT DATA

The next example is that of a partial listing of any actual event which would be saved assuming the use of the default parameters in the system. Note that the length of an actual event is always very long (greater than ten data points) when compared to a keypad event. Also, the last data point just after the real-time clock information is the average value from the running average table just prior to the recording of this event. This piece of information is the only data not retrievable from the system data for post test analysis and is included here for analysis purposes. All data are stored in raw A/D counts.

HEX VALUE	BINARY VALUE	DESCRIPTION
EB90	1110101110010000	barker Code
EB90	1110101110010000	barker Code
EB90	1110101110010000	barker Code
0010	0000000000010000	First Data Point
	.	(voltage value for 99 dB)
	.	
0041	0000000001000001	
05B7	0000010110110111	
392C	0011100100101100	Peak Value (count of 14636 =
	.	voltage value for 158.3 dB)
	.	
	.	Other Data Points for
	.	recorded Boom Event
000C	000000000001100	
0006	000000000000110	Last Data Point (count of 6 = voltage value for 90.6 dB)
xxxx	xxxxxxxxxxxxxxx	Real-Time: Minute and Second
xxxx	xxxxxxxxxxxxxxx	Real-Time: Day and Hour
xxxx	xxxxxxxxxxxxxxx	Real-Time: Year and Month
0001	000000000000001	2 seconds Average Noise Level Prior to this Event (count of 1 = voltage value for 75 dB)
EB90	1110101110010000	barker Code
EB90	1110101110010000	barker Code
EB90	1110101110010000	barker Code

3.6 Error Messages and Recovery Procedures

MESSAGE	REASON AND/OR RECOVERY
RAM	CHECK SUM MISMATCH IN PROM DURING POWER-UP DIAGNOSTICS RECOVERY: POWER DOWN UNIT POWER ON UNIT IF ERROR STILL OCCURS, SERVICE IS REQUIRED
STATIC RAM ERROR	READ/WRITE ERROR IN THE STATIC RAM DURING POWER-UP DIAGNOSTICS RECOVERY: POWER DOWN UNIT POWER ON UNIT IF ERROR STILL OCCURS, SERVICE IS REQUIRED
BAT RAM ERROR	READ/WRITE ERROR IN THE BATTERY RAM MODULES DURING POWER-UP DIAGNOSTICS RECOVERY: POWER DOWN UNIT RESEAT BATTERY RAM
MODULES	
	POWER ON UNIT IF ERROR STILL OCCURS, POWER DOWN UNIT.
REPLACE	
	BATTERY RAM MODULES POWER ON UNIT IF ERROR STILL OCCURS, SERVICE IS REQUIRED
KEY ENTRY ERROR	DISPLAYED WHEN AN INVALID KEYPAD ENTRY IS MADE DURING A PARAMETER CHANGE RECOVERY: PRESS THE "CLR" KEY PRESS THE FUNCTION KEY DESIRED PRESS THE "ENT" KEY
INVALID NUMBER	DISPLAYED WHEN AN INVALID OR OUT OF RANGE VALUE IS ENTERED FOR A PARAMETER DURING A PARAMETER CHANGE RECOVERY: SAME AS "KEY ENTRY ERROR"

NOT ACTIVE

DISPLAYED WHEN AN INVALID FUNCTION KEY IS SELECTED

RECOVERY: PRESS "*" TO TURN DISPLAY OFF
PRESS "*" TO TURN DISPLAY ON
ENTER A DIFFERENT FUNCTION KEY

ENTER CODE

DISPLAYED WHEN THE FULL SYSTEM RESET FUNCTION IS SELECTED. THE OPERATOR SHOULD ENTER THE RESET CODE SEQUENCE

READY

DISPLAYED AFTER THE POWER-UP DIAGNOSTICS HAVE BEEN SUCCESSFULLY COMPLETED

000-YES/NO-000

DISPLAYS THE NUMBER OF VALID SONIC BOOMS (YES), AND INVALID EVENTS (NO) THAT HAVE BEEN DETECTED. THESE COUNTERS ARE RESET DURING POWER-UP OR SYSTEM RESET

BAT RAM FULL

DISPLAYED WHEN THE EVENTS RECORDED HAVE FILLED THE BATTERY RAM MODULES

RECOVERY: POWER DOWN THE UNIT
REPLACE THE BATTERY RAMs WITH NEW MODULES
POWER THE UNIT ON

SYSTEM IS RESET

DISPLAYED AFTER THE FULL SYSTEM RESET FUNCTION HAS BEEN SUCCESSFULLY COMPLETED. WHEN DIAGNOSTICS HAVE BEEN COMPLETED, THE "READY" MESSAGE IS DISPLAYED

3.7 Software Listing

```
LOCATION OBJECT CODE LINE     SOURCE LINE

         '68000'


*
******************************************************************
*
*                     BEAR
*
*    This program records sonic  data onto the battery ram
*    modules in search of a sonic boom. Once an end of event
*    is detected,the data is analyzed to determine if the
*    event was a sonic boom. If so,the data is retained.The
*    BEAR program also services the keypad which allows an
*    operator to enter time and date information ,as well as
*    parameters for analyzing the data.
*    Once the software system is initialized,the BEAR is
*    strictly interrupt driven.The interrupts that are
*    serviced are:the A/D interrupt for data collection,
*    and the keypad interrupt for parameter entry. Timers 1 & 2,
*    which determine the end of an event collection, are software
*    maintained timers.
*    As part of the initialization, a power up diagnostic
*    is performed in which the integrity of the EPROM's,
*    System Static Ram, Running Average Table (RAT) Ram and Battery Ram
*    are checked and zeroed. The Battery Ram is zeroed only if valid
*    events are detected upon power up. If an error is detected,
*    an appropriate error message is displayed.
*    The A/D interrupt routine (DAC) processes the input data.
*    It maintains the running average through calls to RAT,
*    and determines when an event has begun. When an event is
*    detected,DAC activates the timers at the appropriate
*    times.
*    The end of an event is caused by either timer1 or timer2 expiring.
*    If the event evaluation routine determines that the data is a
*    sonic boom,the data is retained, else the data pointer
*    is reset and new data will be written over it.
*    The keypad interrupt is serviced by the routine (KEYPD).
*    Whenever a key is depressed,this routine is executed.
*    KEYPD determines if the entry was valid,and if so,stores
*    the data in the systems parameter arrays,as well as,in
*    the Battery Ram.KEYPD also outputs the entered information
*    to the display to provide operator feedback.
*
*    The default parameters for the BEAR are:
*
*      Time: seconds - 0
*            minutes - 0
*            hour    - 0
```

```
            *           day     - 01
            *           month   - 10
            *           year    - 87
            *
            *    Test Number     - 0
            *    Site Number     - 0
            *    Serial Number   - 0
            *    Timer 1         - 2 sec.
            *    Timer 2         - .2 sec.
            *    Jump Value      - 10
            *    Trigger 2       - 100 db
            *    Trigger 3       - 107 db
            *    Peak Slope db   - 6 db
            *    Peak Slope time - 35 msec.
            *
            *    The register utilization by the BEAR is :
            *
            *    D0 - NEWEST DATA        A0 - GENERAL USE
            *    D1 - OLDEST DATA        A1 - BEGINNING OF EVENT (FLAG 1)
            *    D2 - CURRENT PEAK       A2 - DOWN CROSSING (FLAG 2)
            *    D3 - AVERAGE            A3 - CURRENT DATA POINT (FLAG 3)
            *    D4 - MOVING TOTAL       A4 - PEAK VALUE POINTER (FLAG 4)
            *    D5 - GENERAL USE        A5 - NEGITIVE PEAK POINTER
            *    D6 -   "      "         A6 - OLDEST RAT VALUE POINTER
            *    D7 -   "      "         A7 - STACK POINTER
            *
            *
            *    TRIGR1 - POSITIVE PULSE TIME
            *    TRIGR2 - SECOND JUMP VALUE
            *    TRIGR3 - PEAK TRIGGER VALUE
            *    TIMR1   - EVENT TIMER
            *    TIMR2   - INTERVAL TIMER
            *    TEST     - STATUS WORD
            *
            *                 BIT 0      1 = RISING SLOPE    0 = FALLING SLOPE
            *                 BIT 1      1 = TIMER 1 ON      0 = TIMER 1 OFF
            *                 BIT 2      1 = TIMER 2 ON      0 = TIMER 2 OFF
            *                 BIT 3      1 = INITIALIZE RAT 0 = INIT. COMPLETE
            *
            *
            ##################################################################
            *
            *
    (0000)  PROM     EQU      0000H        PROM START ADDRESS
    (7FFE)  ENDPRM   EQU      7FFEH        PROM END ADDRESS
    (8000)  SRAM     EQU      8000H        STATIC RAM START
    (8FFF)  ENDSRM   EQU      8FFFH        STATIC RAM END
(00018001)  BRAMON   EQU      18001H       BAT. RAM ON/OFF LOC.
(00800000)  BRAM     EQU      800000H      BATTERY RAM START
(0087FDF0)  ENDBRM   EQU      87FDF0H      END OF BAT. RAM
```

```
(0087A030)   99 ENDDATA  EQU      87A030H      END OF VALID DATA
(0087FE00)  100 VARSTR   EQU      87FE00H      PARAMETER STORAGE
            101 * ENDRAT EQU      8DFFFEH      END OF RAT TABLE (MODEL BBE)
            102 * SIZE1  EQU      8DBFFCH      % 1 SEC. AVG START (MODEL BBE)
            103 * SIZE2  EQU      8D7FFCH      2 SEC. AVG START (MODEL BBE)
            104 * SIZE3  EQU      8CFFFCH      % 4 SEC. AVG START (MODEL BBE)
            105 * SIZE4  EQU      8C0000H      % 8 SEC. AVG START (MODEL BBE)
(008C0000)  106 STRAT    EQU      8C0000H      START OF RAT RAM
(008CFFFE)  107 ENDRAT   EQU      8CFFFEH      % END OF RAT TABLE (MODEL 1020)
(008CC000)  108 SIZE1    EQU      8CC000H      % 1 SEC. AVG START (MODEL 1020)
(008C8000)  109 SIZE2    EQU      8C8000H      % 2 SEC. AVG START (MODEL 1020)
(008C0000)  110 SIZE3    EQU      8C0000H      % 4 SEC. AVG START (MODEL 1020)
(008C0000)  111 SIZE4    EQU      8C0000H      % 8 SEC. AVG START (MODEL 1020)NON-FUNC
(00010000)  112 ADC      EQU      10000H       A/D DATA ADDRESS
(00020000)  113 DISPLY   EQU      20000H       DISPLAY ADDRESS
(00028000)  114 PIA      EQU      28000H       I/O ADDRESS
    (0001)  115 ADATA    EQU      1            PIA A DATA REGISTER
    (0001)  116 ADDR     EQU      1            PIA A DIR REGISTER
    (0003)  117 ACNTL    EQU      3            PIA STATUS/CONTROL
    (0005)  118 BDATA    EQU      5            PIA B DATA REGISTER
    (0005)  119 BDDR     EQU      5            PIA B DIR REGISTER
    (0007)  120 BCNTL    EQU      7            PIA B STATUS/CONTROL
    (0020)  121 HOLD     EQU      20H          RTC HOLD
    (0060)  122 READ     EQU      60H          RTC READ/HOLD
    (00A0)  123 WRITE    EQU      0A0H         RTC WRITE/HOLD
    (0082)  124 TIMCONT  EQU      82H          TIMER CONTROL
    (00E1)  125 IRQEN    EQU      0E1H         TIMER ONE SHOT
    (00A0)  126 STTIM3   EQU      0A0H         TIMER 3 ENABLE
    (00E0)  127 STTIM    EQU      0E0H         START TIMERS
    (0035)  128 ADENA    EQU      35H          ENABLE A/D INT.
    (0005)  129 T1MSB    EQU      5            TIMER 1 MSB
    (0007)  130 T1LSB    EQU      7            TIMER 1 LSB
    (0009)  131 T2MSB    EQU      9            TIMER 2 MSB
    (000B)  132 T2LSB    EQU      0BH          TIMER 2 LSB
    (000D)  133 T3MSB    EQU      0DH          TIMER 3 MSB
    (000F)  134 T3LSB    EQU      0FH          TIMER 3 LSB
    (00A1)  135 DIST2    EQU      0A1H         DISABLE TIMER 2
    (0001)  136 T1CNTRL  EQU      1            TIMER 1 CONTROL
    (0003)  137 T2CNTRL  EQU      3            TIMER 2 CONTROL
(00030000)  138 TIMADDR  EQU      30000H       TIMER ADDRESS
    (0001)  139 TSTAT    EQU      1            TIMER STATUS
    (0020)  140 PRVTRP   EQU      20H          PRIVELAGE TRAP VECTOR
    (0064)  141 AUTOV1   EQU      64H          AUTOVECTOR 1
    (0068)  142 AUTOV2   EQU      68H                     2
    (006C)  143 AUTOV3   EQU      6CH                     3
    (0070)  144 AUTOV4   EQU      70H                     4
    (0074)  145 AUTOV5   EQU      74H                     5
    (0078)  146 AUTOV6   EQU      78H                     6
    (007C)  147 AUTOV7   EQU      7CH                     7
            148
```

```
          <20202020>   149 BLNK     EQU     '    '       BLANK WORD
              <EB90>   150 BARKER   EQU     0EB90H       BARKER CODE
              <8FFE>   151 STACK    EQU     8FFEH        START OF SYSTEM STACK
              <8F00>   152 SYSTK    EQU     8F00H        START OF SYSTEM STACK
              <0000>   153 TNUM     EQU     0            TEST NUMB.
              <0002>   154 SITE     EQU     2            SITE NUMBER
              <0004>   155 SERIAL   EQU     4            SERIAL NUMBER
              <0006>   156 TMFLG1   EQU     6
              <0008>   157 TMVAL1   EQU     8            TIMER 1 VAL
              <000A>   158 TMFLG2   EQU     10
              <000C>   159 TMVAL2   EQU     12           TIMER VALUE 2
              <000E>   160 TRG1     EQU     14           TRIGGER 1
              <0010>   161 TRG2FL   EQU     16
              <0012>   162 TRG2     EQU     18           TRIGGER 2 VALUE
              <0014>   163 TRG3FL   EQU     20
              <0016>   164 TRG3     EQU     22           TRIGGER 3 VALUE
              <0018>   165 PSLOP    EQU     24           PEAK SLOPE IN DB
              <001A>   166 PSLTM    EQU     26           PEAK SLOPE IN TIME
              <001C>   167 MSTIM    EQU     28           MINUTES/SEC.
              <001E>   168 DHTIM    EQU     30           DAY/HOUR
              <0020>   169 YMTIM    EQU     32           YEAR/MONTH
              <0000>   170 NUL      EQU     0
                       171          ORG     SRAM         START OF STATIC RAM
008000 0000            172 TRIGR1H  DC.W    0
008002 0000            173 TRIGR1   DC.W    0            TRIGGER 1 IN COUNTS
008004 0000            174 TRIGR2H  DC.W    0
008006 0000            175 TRIGR2   DC.W    0            TRIGGER 2 IN COUNTS
008008 0000            176 TRIGR3H  DC.W    0
00800A 0000            177 TRIGR3   DC.W    0            TRIGGER 3 IN COUNTS
00800C 0000            178 TIMR1    DC.W    0            TIMER 1 IN COUNTS
00800E 0000            179 TIMR2    DC.W    0            TIMER 2 IN COUNTS
008010                 180 TSTINF   DS.W    17           CONTAINS THE TEST INFO FROM THE
              <8030>   181 INFEND   EQU     *-2          HEADER BLOCK
008032 0000            182 CLK1     DC.W    0            MIN/SEC VALUE
008034 0000            183 CLK2     DC.W    0            HOUR / DAY VALUE
008036 0000            184 CLK3     DC.W    0            YEAR / MONTH VALUE
008038                 185 SEC1     DS.B    1            SECONDS
008039                 186 MIN1     DS.B    1            MINUTES
00803A                 187 HOUR1    DS.B    1            HOURS
00803B                 188 DAY1     DS.B    1            DAYS
00803C                 189 MONTH1   DS.B    1            MONTH
00803D                 190 YEAR1    DS.B    1            YEARS
00803E                 191 PORTAD   DS.B    1            PORT A DATA
00803F                 192 PORTAC   DS.B    1            PORT A COMMAND
008040                 193 PORTBD   DS.B    1            PORT B DATA
008041                 194 PORTBC   DS.B    1            PORT B COMMAND
008042                 195 KEYIN    DS.B    1            KEYBOARD INPUT VALUE
008044 0000            196          DC.W    0
008046                 197 CURPNT   DS.L    1            SAVE AREA FOR CURRENT DATA POINTER
00804A                 198 CURAVG   DS.W    1            SAVE AREA FOR CURRENT AVERAGE
```

```
00804C 0000 0000    199 TEMPT1   DC.L    0
008050 0000 0000    200 TEMPT2   DC.L    0
008054 0000 0000    201 NEGPK    DC.L    0              NEGITIVE PEAK VALUE
008058 0000 0000    202 BOTRAT   DC.L    0              BOTTOM OF RAT
00805C 0000 0000    203 EVNTCNT  DC.L    0              COUNTER FOR EVENT DURATION
008060 0000 0000    204 T2CNT    DC.L    0              COUNTER FOR TIMER 2 DURATION
008064 0000         205 MEMSTAT  DC.W    0              STATUS OF MEMORY DIAGNOSTIC
008066 0000         206 VBOOM    DC.W    0              VALID BOOM COUNT
008068 0000         207 NVBOOM   DC.W    0              NON-VALID BOOM COUNT
00806A              208 BOOMSG1  DS.B    13             BOOM COUNT MSG
008077              209 BOOMSG2  DS.B    3                "    "    " CONTINUED
00807A 0000         210          DC.W    0
00807C              211 CALMSG   DS.B    16             CAL DISPLAY MSG BUFFER
00808C              212 ADMSG    DS.B    6              CAL 2 DISPLAY MSG
008092              213 DATMSG   DS.B    10
00809C              214 MEMMSG   DS.B    16             MEMORY LEFT MESSAGE
0080AC 0000         215 PWRUP    DC.W    0              POWER UP FLAG
0080AE 0000         216 PWRCNT   DC.W    0
0080B0 0000         217 CALFLG   DC.W    0              CAL MODE FLAG
0080B2 0000 0000    218 CALSUM   DC.L    0              SUM  VALUE DURING CAL.
0080B6 0000         219 CALTIM   DC.W    0              CAL. PERIOD
0080B8 00           220 HUND     DC.B    0              DECIMAL CONVERSION VALUE (100'S)
0080B9 00           221 TEN      DC.B    0                "         "          "    (10'S)
0080BA 00           222 UNIT     DC.B    0                "         "          "    (1'S)
0080BC 0000         223          DC.W    0
0080BE              224 AKDATA   DS.B    16             A FUNCTION DATA
0080CE              225 BKDATA   DS.B    16             B FUNCTION DATA
0080DE              226 DKDATA   DS.B    16             D FUNCTION DATA
0080EE 00           227 TEST     DC.B    0              TEST STATUS
0080F0 0000         228          DC.W    0
0080F2 0000 0000    229 LSTEVT   DC.L    0              LAST EVENT ADDR.
0080F6 0000         230 RSTFLG   DC.W    0
0080F8 0000         231 RSTMSK   DC.W    0
0080FA 0000         232 MSTRST   DC.W    0
0080FC 0000         233 DATSAV   DC.W    0
0080FE 0000         234 ADVAL    DC.W    0              A/D VAL FOR CAL 2
008100 0000         235 ADSPFLG  DC.W    0              CAL 2 FLAG
008102 0000         236 BOOMFLG  DC.W    0
008104 0000 0000    237 TR2HIGH  DC.L    0              POS. TRIG 2
008108 0000 0000    238 TR2LOW   DC.L    0              NEG. TRIG 2
00810C 0000         239          DC.W    0
           (810E)   240 ENDVAR   EQU     *              END OF PARAMETERS
           (00F8)   241 MSKOFF   EQU     RSTMSK-SRAM    % ADDRESS OFFSET
                    242 ;:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                    243 ;   DECLARE STORAGE FOR KEYPAD VARIABLES
                    244 ;:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                    245
00810E 00           246 DSPADR   DC.B    0H             CHARACTER LOCATION TO DISPLAY
00810F 00           247 DUMMY    DC.B    0H             PUTS EVERYTHING ON A WORD BOUNDRY
008110 0000         248 DIGITS   DC.W    0H             SAVE AREA FOR MULT
```

```
008112 0000          249 KEY     DC.W      0H          KEY ENTERED
008114 0000          250 FUNCT   DC.W      0H          LAST FUNCTION CODE ENTERED
008116 0000          251 OFF     DC.W      0H          DISPLAY ON/OFF FLAG
008118 0000          252 ERRNUM  DC.W      0H          KEYBOARD ERROR CODE
00811A 0000          253 ALPHA   DC.W      0H          LAST ALPHA CHARACTER ENTERED
00811C 0000          254 COUNT   DC.W      0H          KEYPAD CHARACTER COUNT
00811E 0000          255 POINT   DC.W      0H          DECIMAL POINT ON/OFF FLAG
008120 0000          256 HIYR    DC.W      0H          BEGINNING OF AKEY DATA
008122 0000          257 LOYR    DC.W      0H          YEAR
008124 0000          258 HIMO    DC.W      0H          MONTH
008126 0000          259 LOMO    DC.W      0H
008128 0000          260 HIDA    DC.W      0H          DAY
00812A 0000          261 LODA    DC.W      0H
00812C 0000          262 HIHR    DC.W      0H          HOUR
00812E 0000          263 LOHR    DC.W      0H
008130 0000          264 HIMN    DC.W      0H          MINUTE
008132 0000          265 LOMN    DC.W      0H
008134 0000          266 HISC    DC.W      0H          SECOND
008136 0000          267 LOSC    DC.W      0H
008138 0000          268 HITT    DC.W      0H          BEGINNING OF BKEY DATA
00813A 0000          269 LOTT    DC.W      0H          TEST NUMBER
00813C 0000          270 HISN    DC.W      0H          SITE NUMBER
00813E 0000          271 LOSN    DC.W      0H
008140 0000          272 HIT1    DC.W      0H          TIMER 1
008142 0000          273 LOT1    DC.W      0H
008144 0000          274 HIT2    DC.W      0H          TIMER 2
008146 0000          275 LOT2    DC.W      0H
008148 0000          276 SN1     DC.W      0H          SERIAL NUMBER
00814A 0000          277 SN2     DC.W      0H
00814C 0000          278 SN3     DC.W      0H
00814E 0000          279 SN4     DC.W      0H
008150 0000          280 HITR3   DC.W      0H          BEGINNING OF DKEY DATA
008152 0000          281 MITR3   DC.W      0H          TRIGGER 3
008154 0000          282 LOTR3   DC.W      0H
008156 0000          283 HITR2   DC.W      0H          TRIGGER2
008158 0000          284 MITR2   DC.W      0H
00815A 0000          285 LOTR2   DC.W      0H
00815C 0000          286 HIJV    DC.W      0H          JUMP VALUE
00815E 0000          287 LOJV    DC.W      0H
008160 0000          288 HIRV    DC.W      0H          RISE DB
008162 0000          289 LORV    DC.W      0H
008164 0000          290 HIRT    DC.W      0H          RISE TIME
008166 0000          291 LORT    DC.W      0H
008168 0000          292 YEAR    DC.W      0H          YEAR CONVERTED
00816A 0000          293 MONTH   DC.W      0H          MONTH   "
00816C 0000          294 DAY     DC.W      0H          DAY     "
00816E 0000          295 HOUR    DC.W      0H          HOUR    "
008170 0000          296 MINUTE  DC.W      0H          MINUTE  "
008172 0000          297 SECOND  DC.W      0H          SECOND  "
008174 0000          298 TESTNM  DC.W      0H          TEST NO. "
```

```
008176 0000         299 SITENM   DC.W     0H             SITE NO.
008178 0000         300 TIMER1   DC.W     0H             TIMER 1
00817A 0000         301 TIMER2   DC.W     0H             TIMER 2
00817C 0000         302 SERNO    DC.W     0H             SERIAL NO.
00817E 0000         303 TRIG3    DC.W     0H             TRIGGER 3
008180 0000         304 TRIG2    DC.W     0H             TRIGGER 2
008182 0000         305 JMPVAL   DC.W     0H             JUMP VAL.
008184 0000         306 RISEDB   DC.W     0H             RISE DB
008186 0000         307 RISETM   DC.W     0H             RISE TIME
                    308
                    309
                    310
                    311
                    312
                    313          ORG       PROM          START OF PROM (ADDR. 0)
                    314
000000 0000 8F00    315          DC.L      SYSTK         SYSTEM STACK
000004 0000 03FC    316          DC.L      BEAR          START OF PROGRAM
000008 0000 10BE    317          DC.L      BUSERR        BUS ERROR TRAP
00000C 0000 10C0    318          DC.L      ADDERR        ADDRESS ERROR TRAP
000010 0000 0000    319          DC.L      NUL,NUL,NUL,NUL
000020 0000 03FC    320          DC.L      BEAR          START OF PROGRAM
000024 0000 0000    321          DC.L      NUL,NUL,NUL
000030 0000 0000    322          DC.L      0,0,0
00003C 0000 0000    323          DC.L      NUL
000040 0000 0000    324          DC.L      0,0,0,0
000C50 0000 0000    325          DC.L      0,0,0,0
000060 0000 0000    326          DC.L      NUL
000064 0000 0000    327          DC.L      NUL           START OF AUTOVECTOR     VECTOR 1
000068 0000 0A52    328          DC.L      DAC           A/D INTERRUPT           VECTOR 2
00006C 0000 25B6    329          DC.L      LITNG         LIGHTNING INTERRUPT     VECTOR 3
000070 0000 0000    330          DC.L      NUL                                   VECTOR 4
000074 0000 10C2    331          DC.L      KEYPD         KEY PAD IRQ             VECTOR 5
000078 0000 2184    332          DC.L      TIMER         PROGM TIMER IRQ         VECTOR 6
00007C 0000 0000    333          DC.L      NUL                                   VECTOR 7
000080 0000 0000    334          DC.L      NUL
000084              335          DS.L      11
0000B0 0000 0000    336          DC.L      NUL
0000B4 0000 0000    337          DC.L      NUL
0000B8 0000 0000    338          DC.L      NUL
0000BC              339 EMPTY    DS.L      208
                    340
                    341
                    342
0003FC 4E71         343 BEAR     NOP
0003FE 4FF9 0000    344          LEA.L     STACK,A7
000404 46FC 2700    345          MOVE.W    #2700H,SR
000408 4FF9 0000    346          LEA.L     SYSTK,A7
                    347
00040E 08B9 0000    348          BCLR      #0,BRAMON     TURN ON BAT. RAM
```

```
000416 243C                        MOVE.L   #100,D2
00041C 6100 0C9A                   BSR      DELAY
000420 4287                        CLR.L    D7

                      *
                      ############################################################
                      *
                      *     THIS SECTION BEGINS THE POWER UP DIAGNOSTICS.
                      *     IT PERFORMS A CHECK SUM CHECK OF THE PROM THEN
                      *     DOES A WRITE AND READ CHECK OF THE STATIC RAM ,
                      *     AND BATTERY RAM .
                      *
                      *      ERROR STATUS IS STORED IN D7 :
                      *         0 - EPROM ERROR
                      *         1 - SYSTEM STATIC RAM ERROR
                      *         2 - RAT OR BATTERY RAM ERROR
                      *
                      ############################################################
                      *

                      * DIGSTRT  MOVE.W   #0,RSTFLG      CLEAR RESET FLAG
000422 41F8 0000      ROMDIG     LEA.L    PROM,A0        GET START OF PROM
000426 203C                      MOVE.L   #ENDPRM,D0      GET END OF PROM
00042C 4281                      CLR.L    D1             ZERO SUMMING REG.
00042E D258           ROMLP      ADD.W    (A0)+,D1        SUM PROM ON WORD BOUNDARY
000430 B1C0                      CMPA.L   D0,A0          CHECK FOR END OF PROM
000432 66FA                      BNE      ROMLP
000434 B250                      CMP.W    (A0),D1       CHECK CHECKSUM
000436 6700 0006                 BEQ      SRAMDIG        IF NOT = GOTO ERR
00043A 08C7 0000                 BSET     #0,D7          SET ERROR BIT
00043E 41F9 0000      SRAMDIG    LEA.L    SRAM,A0        GET START OF STATIC RAM
000444 203C                      MOVE.L   #ENDSRM,D0      GET END OF STATIC RAM
00044A 323C AAAA                 MOVE.W   #0AAAAH,D1      INIT FIRST MASK
00044E 343C 5555                 MOVE.W   #5555H,D2      INIT SECOND MASK
000452 3081           SLOOP      MOVE.W   D1,(A0)        WRITE MASK
000454 B250                      CMP.W    (A0),D1        READ/CMPR MASK
000456 6700 0006                 BEQ      SLP1
00045A 08C7 0001                 BSET     #1,D7          SET ERROR BIT
00045E 3082           SLP1       MOVE.W   D2,(A0)        WRITE SECOND MASK
000460 B450                      CMP.W    (A0),D2        READ/CMPR
000462 6700 0006                 BEQ      SLP2
000466 08C7 0001                 BSET     #1,D7          SET ERROR BIT
00046A 4250           SLP2       CLR.W    (A0)           ZERO MEMORY LOCATION
00046C D1FC                      ADDA.L   #2,A0          INCR ADDR POINTER
000472 B1C0                      CMPA.L   D0,A0          CHECK FOR END
000474 6FDC                      BLE      SLOOP
000476 41F9 008C      RATRAM     LEA.L    STRAT,A0       GET START OF RAT RAM
00047C 203C                      MOVE.L   #ENDRAT,D0      GET END
000482 223C                      MOVE.L   #0A5A5H,D1     LOAD MASK
000488 30C1           RATWRT     MOVE.W   D1,(A0)+       WRITE MASK
```

```
00048A B1C0         399          CMPA.L   D0,A0          CHECK FOR END OF RAT
00048C 6FFA         400          BLE      RATWRT         WRITE NEXT WORD
00048E 41F9 008C    401          LEA.L    STRAT,A0       GET START OF RAT
000494 3410         402 RATLP    MOVE.W   [A0],D2        FETCH DATA
000496 B441         403          CMP.W    D1,D2          CHECK DATA
000498 6600 000C    404          BNE      ENDTST         TEST FAILED
00049C 4258         405          CLR.W    [A0]+          ZERO WORD
00049E B1C0         406          CMPA.L   D0,A0          CHECK FOR END OF RAT
0004A0 6FF2         407          BLE      RATLP          DO AGAIN
0004A2 6000 0006    408          BRA      CONBRAM        PASSED TEST
0004A6 08C7 0002    409 ENDTST   BSET     #2,D7          FAILED TEST
0004AA 41F9 0087    410 CONBRAM  LEA.L    VARSTR,A0      % GET BRAM PARAMETERS START ADDR
0004B0 0C68 ABCD    411          CMPI.W    #0ABCDH,MSKOFF[A0]  % CHECK BRAM DATA GOOD MASK
0004B6 6600 001E    412          BNE      BRAMDIG        % IF NO GOOD, PERFORM BRAMDIAG
0004BA 43F9 0000    413          LEA.L    SRAM,A1        % ELSE MOVE PARAMETERS TO STATIC RAM
0004C0 12D8         414 RELOAD   MOVE.B   [A0]+,[A1]+    %
0004C2 B3FC         415          CMPA.L   #ENDVAR,A1     %
0004C8 6DF6         416          BLT      RELOAD         %
0004CA 33FC 0001    417          MOVE.W   #1,RSTFLG      % FLAG BRAM AS GOOD
0004D2 6000 003E    418          BRA      INIPIA         % INITIALIZE PIA
                    419 * CONBRAM  LEA.L    VARSTR,A0      LOAD PARAMETERS FROM BRAM
                    420 *          LEA.L    SRAM,A1          TO STATIC RAM
                    421 * RELOAD   MOVE.B   [A0]+,[A1]+
                    422 *          CMPA.L   #ENDVAR,A1
                    423 *          BLT      RELOAD
                    424 *          CMP.W    #0ABCDH,RSTMSK   IF BRAM DATA STILL GOOD
                    425 *          BNE      BRAMDIG
                    426 *          MOVE.W   #1,RSTFLG
                    427 *          BRA      INIPIA               GO TO DATA ACQ.
0004D6 41F9 0080    428 BRAMDIG  LEA.L    BRAM,A0        START OF BAT. RAM
0004DC 203C         429          MOVE.L   #ENDBRM,D0
0004E2 223C         430          MOVE.L   #0A5A5H,D1      SET UP MASK
0004E8 30C1         431 BRMWRT   MOVE.W   D1,[A0]+
0004EA B1C0         432          CMPA.L   D0,A0          CHECK FOR END
0004EC 6FFA         433          BLE      BRMWRT
0004EE 41F9 0080    434          LEA.L    BRAM,A0        GET START ADDRESS
0004F4 203C         435          MOVE.L   #ENDBRM,D0     END ADDRESS
0004FA 3410         436 BLOOP    MOVE.W   [A0],D2        READ DATA
0004FC B441         437          CMP.W    D1,D2
0004FE 6600 0008    438          BNE      ENDRAM         IF NE THIS IS END OF RAM
000502 4258         439          CLR.W    [A0]+          ZERO BRAM
000504 B1C0         440          CMPA.L   D0,A0          CHECK FOR END
000506 6FF2         441          BLE      BLOOP
000508 B1C0         442 ENDRAM   CMPA.L   D0,A0          CHECK FOR GOOD TEST
00050A 6C00 0006    443          BGE      INIPIA         TEST PASSED
00050E 08C7 0002    444          BSET     #2,D7          FAILED
                    445
                    446
                    447 *
                    448 *     INITIALIZATION SECTION
```

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                     *
                     *
                     *
                     *     INITIALIZE THE I / O PORTS
                     *
                     *
000512 41F9 0002     INIPIA  LEA.L    PIA,A0          GET I/O PORT ADDRESS
000518 117C 0000             MOVE.B   #0,ACNTL[A0]    CLEAR CONTROL
00051E 117C 0000             MOVE.B   #0,BCNTL[A0]
000524 117C 00E0             MOVE.B   #0E0H,ADDR[A0]  SET DIRECTION OF PORT
00052A 117C 00F0             MOVE.B   #0F0H,BDDR[A0]
000530 117C 003F             MOVE.B   #3FH,ACNTL[A0]  SET CONTROL BITS
000536 13FC 003F             MOVE.B   #3FH,PORTAC
00053E 117C 0000             MOVE.B   #0,ADATA[A0]    ZERO DATA REGISTER
000544 13FC 0000             MOVE.B   #0,PORTAD
00054C 117C 0036             MOVE.B   #36H,BCNTL[A0]  SET CONTROL OF OTHER PORT
000552 13FC 0036             MOVE.B   #36H,PORTBC
00055A 117C 0000             MOVE.B   #0,BDATA[A0]    ZERO DATA REGISTER
000560 13FC 0000             MOVE.B   #0,PORTBD
000568 0C87                  CMP.L    #0,D7           SEE IF THERE WERE ANY DIAG ERROR
00056E 6600 0AA2             BNE      MEMERR          YES,DISPLAY ERROR
000572 0C79 0001             CMPI.W    #1,RSTFLG      % IF NON RESET
00057A 6600 0010             BNE      NONRST          INIT. BRAM PARAMETERS
00057E 6100 081C             BSR      WRTCLK
000582 2679 0000             MOVEA.L  LSTEVT,A3       ELSE MOVE POINTER TO LAST
                             MOVE.W   #0,RSTFLG         DATA POINT
000588 6000 0178             BRA      TIMINI


00058C 13FC 0000     NONRST  MOVE.B   #0,SEC1         INITIALIZE TIME  OF DAY CLOCK
000594 13FC 0000             MOVE.B   #00,MIN1        MINUTES = 0
00059C 13FC 0000             MOVE.B   #00,HOUR1       HOUR = 0
0005A4 13FC 0020             MOVE.B   #20H,DAY1       % DAY = 20
0005AC 13FC 0005             MOVE.B   #05H,MONTH1     % MONTH = 05
0005B4 13FC 0088             MOVE.B   #88H,YEAR1      YEAR = 88
0005BC 6100 07DE             BSR      WRTCLK          WRITE DATA TO REAL TIME CLOCK
0005C0 41F9 0000             LEA.L    AKDATA,A0       LOAD DISPLAY INFO
0005C6 43F9 0000             LEA.L    AKINIT,A1       TRANSFER INITIAL VALUES FROM
0005CC 203C                  MOVE.L   #47,D0          ROM TO STATIC RAM
0005D2 10D9          KDATIN  MOVE.B   [A1]+,[A0]+
0005D4 51C8 FFFC             DBRA     D0,KDATIN
0005D8 47F9 0080             LEA.L    BRAM,A3         GET START OF BATTERY RAM
0005DE 41F9 0000             LEA.L    HEADR,A0        GET HEADER INFO
0005E4 323C 000E             MOVE.W   #14,D1          LOAD MESSAGE COUNT
0005E8 36FC EB90             MOVE.W   #BARKER,[A3]+    PUT IN FIRST BARKER CODES
0005EC 36FC EB90             MOVE.W   #BARKER,[A3]+
0005F0 36FC EB90             MOVE.W   #BARKER,[A3]+
0005F4 36FC EB90             MOVE.W   #BARKER,[A3]+
0005F8 36FC EB90             MOVE.W   #BARKER,[A3]+
0005FC 36D8          INILP   MOVE.W   [A0]+,[A3]+     STORE DEFAULT VALS. IN BRAM
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0005FE 0441 0001   499        SUB.W    #1,D1
000602 66F8        500        BNE      INILP
000604 6100 086E   501        BSR      RDCLK            GET TIME OF DAY
000608 36F9 0000   502        MOVE.W   CLK1,[A3]+       STORE CURRENT TIME OF DAY
00060E 36F9 0000   503        MOVE.W   CLK2,[A3]+
000614 36F9 0000   504        MOVE.W   CLK3,[A3]+
00061A 36FC EB90   505        MOVE.W   #BARKER,[A3]+     PUT IN NEXT BARKER CODES
00061E 36FC EB90   506        MOVE.W   #BARKER,[A3]+
000622 36BC EB90   507        MOVE.W   #BARKER,[A3]
000626 41F9 0000   508        LEA.L    HEADR,A0         PUT HEADER INFO
00062C 43F9 0000   509        LEA.L    TSTINF,A1        INTO SRAM ARRAY
000632 3218        510        MOVE.W   [A0]+,D1         GET TEST NUMBER
000634 0241 0FFF   511        AND.W    #0FFFH,D1         MASK OFF CODE
000638 32C1        512        MOVE.W   D1,[A1]+         AND STORE
00063A 3218        513        MOVE.W   [A0]+,D1         GET SITE NUMBER
00063C 0241 0FFF   514        AND.W    #0FFFH,D1
000640 32C1        515        MOVE.W   D1,[A1]+
000642 3218        516        MOVE.W   [A0]+,D1         GET SERIAL NUMBER
000644 0241 0FFF   517        AND.W    #0FFFH,D1
000648 32C1        518        MOVE.W   D1,[A1]+
00064A D1FC        519        ADDA.L   #2,A0            BUMP PAST FLAG
000650 D3FC        520        ADDA.L   #2,A1
000656 33D0 0000   521        MOVE.W   [A0],TIMR1
00065C 32D8        522        MOVE.W   [A0]+,[A1]+      STORE TIMER 1 VALUE
00065E D1FC        523        ADDA.L   #2,A0            BUMP PAST FLAG
000664 D3FC        524        ADDA.L   #2,A1
00066A 33D0 0000   525        MOVE.W   [A0],TIMR2
000670 32D8        526        MOVE.W   [A0]+,[A1]+      STORE TIMER 2 VALUE
000672 3218        527        MOVE.W   [A0]+,D1         GETY TRIGGER 1
000674 0241 00FF   528        AND.W    #00FFH,D1
000678 32C1        529        MOVE.W   D1,[A1]+
00067A 33C1 0000   530        MOVE.W   D1,TRIGR1
000680 D1FC        531        ADDA.L   #2,A0            BUMP PAST FLAG
000686 D3FC        532        ADDA.L   #2,A1
00068C 33D0 0000   533        MOVE.W   [A0],TRIGR2
000692 32D8        534        MOVE.W   [A0]+,[A1]+      GET TRIGGER 2
000694 D1FC        535        ADDA.L   #2,A0            BUMP PAST FLAG
00069A D3FC        536        ADDA.L   #2,A1
0006A0 33D0 0000   537        MOVE.W   [A0],TRIGR3
0006A6 32D8        538        MOVE.W   [A0]+,[A1]+      GET TRIGGER 3
0006A8 3218        539        MOVE.W   [A0]+,D1         GET PEAK SLOPE DB VALUE
0006AA 0241 0FFF   540        AND.W    #0FFFH,D1
0006AE 32C1        541        MOVE.W   D1,[A1]+
0006B0 3218        542        MOVE.W   [A0]+,D1         GET PEAK SLOPE TIME VALUE
0006B2 0241 0FFF   543        AND.W    #0FFFH,D1
0006B6 32C1        544        MOVE.W   D1,[A1]+
0006B8 32F9 0000   545        MOVE.W   CLK1,[A1]+       GET MIN. / SEC. VALUE
0006BE 32F9 0000   546        MOVE.W   CLK2,[A1]+       GET DAY / HOUR VALUE
0006C4 32F9 0000   547        MOVE.W   CLK3,[A1]+       GET YEAR / MONTH VALUE
0006CA 41F9 0000   548        LEA.L    BONMSG,A0
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0006D0 43F9 0000               LEA.L     BOOMSG1,A1
0006D6 22D8                    MOVE.L    [A0]+,[A1]+    MOVE IN BOOM COUNT MSG
0006D8 22D8                    MOVE.L    [A0]+,[A1]+    TO STATIC RAM
0006DA 22D8                    MOVE.L    [A0]+,[A1]+
0006DC 2290                    MOVE.L    [A0],[A1]
0006DE 33FC 0000               MOVE.W    #0,VBOOM
0006E6 33FC 0000               MOVE.W    #0,NVBOOM
0006EE 41F9 0000               LEA.L     MEMTEXT,A0     MOVE MEMORY LEFT MSG
0006F4 43F9 0000               LEA.L     MEMMSG,A1      TO STATIC RAM
0006FA 22D8                    MOVE.L    [A0]+,[A1]+
0006FC 22D8                    MOVE.L    [A0]+,[A1]+
0006FE 22D8                    MOVE.L    [A0]+,[A1]+
000700 2290                    MOVE.L    [A0],[A1]




                    ****  INITIALIZE TIMERS   ***


000702 41F9 0003    TIMINI     LEA.L     TIMADDR,A0     GET TIMER I/O ADDRESS
000708 3039 0000               MOVE.W    TIMR1,D0       GET TIMER 1 VALUE
00070E 1200                    MOVE.B    D0,D1
000710 E088                    LSR.L     #8,D0          CONVERT TO TICKS
000712 1140 0005               MOVE.B    D0,T1MSB[A0]   STORE TICK COUNT
000716 1141 0007               MOVE.B    D1,T1LSB[A0]
00071A 3039 0000               MOVE.W    TIMR2,D0       GET TIMER 2
000720 1200                    MOVE.B    D0,D1
000722 E088                    LSR.L     #8,D0          CONVERT TO TICKS
000724 1140 0009               MOVE.B    D0,T2MSB[A0]   STORE TICK COUNT
000728 1141 000B               MOVE.B    D1,T2LSB[A0]
00072C 117C 0000               MOVE.B    #0,T3MSB[A0]   STORE TIMER 3 TICK COUNT
000732 117C 0032               MOVE.B    #50,T3LSB[A0]
000738 117C 0082               MOVE.B    #TIMCONT,T1CNTRL[A0]  DISABLE TIMERS ( RESET )
00073E 117C 00A1               MOVE.B    #DIST2,T2CNTRL[A0]
000744 117C 00A1               MOVE.B    #DIST2,T1CNTRL[A0]
00074A 3C39 0000               MOVE.W    TIMR2,D6
000750 1E06                    MOVE.B    D6,D7
000752 E08E                    LSR.L     #8,D6
000754 1146 0009               MOVE.B    D6,T2MSB[A0]   SEND TIMER 2 VALUE
000758 1147 000B               MOVE.B    D7,T2LSB[A0]
00075C 117C 00E1               MOVE.B    #IRQEN,T2CNTRL[A0]  ENABLE TIMER INTERRUPTS
000762 117C 00E1               MOVE.B    #IRQEN,T1CNTRL[A0]
000768 41F9 0000               LEA.L     CALMSG,A0      POINT TO CAL. MESSAGE BUF.
00076E 20FC                    MOVE.L    #BLNK,[A0]+    BLANK FILL BUFFER
000774 20FC                    MOVE.L    #BLNK,[A0]+
00077A 20FC                    MOVE.L    #BLNK,[A0]+
000780 20BC                    MOVE.L    #BLNK,[A0]
000786 41F9 0000               LEA.L     ADMSG,A0       BLANK CAL 2 DISPLAY MSG
00078C 20FC                    MOVE.L    #BLNK,[A0]+
000792 20FC                MOVE.L    #BLNK,(A0)+
000798 20FC                MOVE.L    #BLNK,(A0)+
00079E 20BC                MOVE.L    #BLNK,(A0)
0007A4 33FC 0000           MOVE.W    #00,ADSPFLG    CLEAR CAL 2 FLG
0007AC 2C39 0000           MOVE.L    TRIGR2H,D6     CALC TR2 HIGH/LOW
0007B2 23C6 0000           MOVE.L    D6,TR2HIGH
0007B8 0486                SUB.L     #8000H,D6
0007BE 23FC                MOVE.L    #8000H,TR2LOW
0007C8 9DB9 0000           SUB.L     D6,TR2LOW



0007CE 33FC 0000           MOVE.W    #00,BOOMFLG
0007D6 6100 196E           BSR       INITDS         INITIALIZE THE DISPLAY


                     ****  INITIALIZE A / D   ****


0007DA 23CB 0000           MOVE.L    A3,LSTEVT
0007E0 23CB 0000           MOVE.L    A3,CURPNT
0007E6 33FC ABCD           MOVE.W    #0ABCDH,RSTMSK
0007EE 6100 1D42           BSR       SAVPAR
0007F2 224B                MOVE.L    A3,A1          INITIALIZE REGISTERS FOR RUN
0007F4 244B                MOVE.L    A3,A2
0007F6 284B                MOVE.L    A3,A4
0007F8 2A4B                MOVE.L    A3,A5
0007FA 23FC                MOVE.L    #SIZE2,BOTRAT   INIT FOR 2 SEC. RAT
000804 2C7C                MOVE.L    #SIZE2,A6
00080A 4280                CLR.L     D0             NEWEST DATA = 0
00080C 4281                CLR.L     D1             LAST DATA = 0
00080E 4282                CLR.L     D2             CURRENT PEAK = 0
000810 4283                CLR.L     D3             AVERAGE = 0
000812 4284                CLR.L     D4             MOVING TOTAL = 0
000814 23FC                MOVE.L    #8000H,NEGPK   INIT NEGITIVE PEAK VALUE
00081E 33FC 000F           MOVE.W    #15,PWRUP      SET POWER UP DELAY - 15 SEC.
000826 33FC 0FA0           MOVE.W    #4000,PWRCNT
00082E 33FC 0000           MOVE.W    #00,DATSAV
000836 33FC 0000           MOVE.W    #00,CALFLG     CLEAR CALIBRATION FLAG
00083E 23FC                MOVE.L    #00,CALSUM     INIT CAL. PEAK VALUE
000848 33FC 0FA0           MOVE.W    #4000,CALTIM     INIT CAL. PERIOD TO 5 MSEC.
000850 13FC 0000           MOVE.B    #0,TEST        CLEAR TEST STATUS
000858 08F9 0003           BSET      #3,TEST        SET FOR RAT INITIALIZATION
000860 46FC 2000           MOVE.W    #2000H,SR      ENABLE INTERRUPTS
000864 41F9 0002           LEA.L     PIA,A0
00086A 13FC 0035           MOVE.B    #ADENA,PORTBC
000872 117C 0035           MOVE.B    #ADENA,BCNTL(A0)  ENABLE A/D INTERRUPT
000878 3E39 0001           MOVE.W    ADC,D7
00087E 1E28 0005           MOVE.B    BDATA(A0),D7
000882 08F9 0000           BSET      #0,BRAMON          TURN OFF BAT. RAM
```

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                   *
                   ***************************************************************
                   *
                   *     THIS IS THE MAIN WAIT LOOP OF THE SYSTEM.THE SYSTEM
                   *     WILL STAY IN THIS LOOP UNTIL AN INTERRUPT OCCURS.
                   *     AFTER THE INTERRUPT IS SERVICED,IT WILL RETURN
                   *     TO THIS LOOP.
                   *
                   ***************************************************************
                   *

00088A 4E71        DLOOP    NOP
00088C 0839 0003            BTST     #3,TEST        WAIT FOR INIT OF RUNNING
000894 66F4                 BNE      DLOOP            AVERAGE TABLE
000896 41F9 0000            LEA.L    RDYMSG,A0
00089C 6100 07DA            BSR      DSPMSG
0008A0 4E71        TLOOP    NOP
0008A2 0839 0000            BTST     #0,ADSPFLG
0008AA 6600 0010            BNE      TLOOP1
0008AE 0839 0000            BTST     #00,CALFLG     SEE IF IN CAL MODE 1
0008B6 6600 0080            BNE      CALDSP         IF YES, DO RMS CAL.
0008BA 60E4                 BRA      TLOOP
0008BC 0C79 0000   TLOOP1   CMPI.W   #0,CALTIM
0008C4 66DA                 BNE      TLOOP
0008C6 33C0 0000            MOVE.W   D0,ADVAL       GET A/D VALUE
0008CC 41F9 0000            LEA.L    DATMSG,A0      LOAD DISPLAY MSG POINTER
0008D2 4286                 CLR.L    D6
0008D4 3C39 0000            MOVE.W   ADVAL,D6       GET LSB OF A/D VALUE
0008DA E04E                 LSR.W    #08,D6
0008DC E84E                 LSR.W    #04,D6
0008DE 6100 0038            BSR      CVTAD          CONVERT A/D VALUE TO ASCII
0008E2 3C39 0000            MOVE.W   ADVAL,D6       GET NEXT NIBBLE OD A/D VAL
0008E8 E04E                 LSR.W    #08,D6
0008EA 6100 002C            BSR      CVTAD          CONVERT TO ASCII
0008EE 3C39 0000            MOVE.W   ADVAL,D6       GET MSB OF A/D VALUE
0008F4 E84E                 LSR.W    #4,D6
0008F6 6100 0020            BSR      CVTAD          CONVERT TO ASCII
0008FA 3C39 0000            MOVE.W   ADVAL,D6       GET HIGH NIBBLE
000900 6100 0016            BSR      CVTAD          CONVERT TO ASCII
000904 41F9 0000            LEA.L    ADMSG,A0       DISPLAY A/D VALUE
00090A 6100 076C            BSR      DSPMSG
00090E 33FC 0FA0            MOVE.W   #4000,CALTIM
000916 6088                 BRA      TLOOP          WAIT FOR INTERRUPTS


000918 0246 000F   CVTAD    AND.W    #0FH,D6        MASK OFF UPPER NIBBLE
00091C 0C46 0009            CMP.W    #09,D6         IF > 9 THEN ALPHA CHAR.
000920 6E00 000A            BGT      ALCHAR
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```
000924 0006 0030                ORI.B    #30H,D6       ELSE NUM. CONVERSION
000928 6000 000A                BRA      STCHAR
00092C 0406 000A        ALCHAR  SUB.B    #0AH,D6       ALPHA CONVERSION
000930 0606 0041                ADD.B    #41H,D6
000934 10C6             STCHAR  MOVE.B   D6,[A0]+      STORE CHAR IN DISPLAY BUF.
000936 4E75                     RTS



                        *
                        ****************************************************************
                        *
                        *    THIS ROUTINE TAKES THE A/D VALUE READ BY DAC IN D2 AND
                        *    CONVERTS IT TO A DB VALUE BY SEARCHING THROUGH THE
                        *    DB TABLE . THE DB VALUE IS THEN CONVERTED TO ASCII AND
                        *    DISPLAYED . THIS PROCESS IS ONLY PERFOMED WHILE IN
                        *    CALIBRATION MODE.
                        *
                        ****************************************************************
                        *
000938 4286             CALDSP  CLR.L    D6
00093A 0C79 0000                CMP.W    #0,CALTIM     CHECK FOR END OF PERIOD
000942 6600 FF5C                BNE      TLOOP         IF NOT RETURN
000946 2C39 0000                MOVE.L   CALSUM,D6     STORE SUM  VALUE
00094C 6100 00E4                BSR      SQRT          CALC SQ. ROOT OF MEAN SQ.
000950 2E3C                     MOVE.L   #DBLEN,D7     GET END OF DB TABLE
000956 0487                     SUB.L    #DBHEX,D7     CALC LENGTH OF DB TABLE
00095C 41F9 0000                LEA.L    DBHEX,A0      POINT TO BEGINNING OF DB TABLE
000962 BC70 7000        CALOP   CMP.W    0[A0,D7],D6   SEARCH TABLE FOR IN VALUE
000966 6C00 0010                BGE      CALFND        MATCH FOUND
00096A 0487                     SUB.L    #1,D7         DECR. TABLE POINTER
000970 51CF FFF0                DBRA     D7,CALOP
000974 6000 FF2A                BRA      TLOOP         RETURN IF SEARCH FAILED
000978 41F9 0000        CALFND  LEA.L    DBTAB,A0      POINT TO DB TRANSLATION TAB.
00097E 3C30 7000                MOVE.W   0[A0,D7],D6   SAVE DB VALUE
000982 41F9 0000                LEA.L    CALMSG,A0     POINT TO CAL MSG. BUFFER
000988 D1FC                     ADD.L    #5,A0         POINT TO MIDDLE OF MSG.
00098E 4247                     CLR.W    D7            ZERO DIGIT COUNTER
000990 10BC 0020                MOVE.B   #20H,[A0]     SPACE FIRST DIGIT
000994 0C46 2710                CMP.W    #10000,D6     SEE IF >= 10,000
000998 6D00 000A                BLT      CAL1
00099C 0446 2710                SUB.W    #10000,D6
0009A0 10BC 0031                MOVE.B   #31H,[A0]     STORE ASCII 1
0009A4 D1FC             CAL1    ADD.L    #1,A0         INCR MSG PNTR
0009AA 0C46 03E8        CAL2    CMP.W    #1000,D6      CONVERT THOUSANDS DIGIT
0009AE 6D00 000C                BLT      CAL2A
0009B2 0446 03E8                SUB.W    #1000,D6
0009B6 0647 0001                ADD.W    #1,D7
0009BA 60EE                     BRA      CAL2
0009BC 0007 0030        CAL2A   OR.B     #30H,D7       CONVERT DIGIT TO ASCII
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0009C0 10C7                      MOVE.B    D7,[A0]+
0009C2 4247                      CLR.W     D7
0009C4 0C46 0064         CAL3    CMP.W     #100,D6        CONVERT HOUNDREDS DIGIT
0009C8 6D00 000C                 BLT       CAL3A
0009CC 0446 0064                 SUB.W     #100,D6
0009D0 0647 0001                 ADD.W     #1,D7
0009D4 60EE                      BRA       CAL3
0009D6 0007 0030         CAL3A   OR.B      #30H,D7        CONVERT DIGIT TO ASCII
0009DA 10C7                      MOVE.B    D7,[A0]+
0009DC 10FC 002E                 MOVE.B    #2EH,[A0]+
0009E0 4247                      CLR.W     D7
0009E2 0C46 000A         CAL4    CMP.W     #10,D6
0009E6 6D00 000C                 BLT       CAL4A          CONVERT TENS DIGIT
0009EA 0446 000A                 SUB.W     #10,D6
0009EE 0647 0001                 ADD.W     #1,D7
0009F2 60EE                      BRA       CAL4
0009F4 0007 0030         CAL4A   OR.B      #30H,D7
0009F8 10C7                      MOVE.B    D7,[A0]+
0009FA 0006 0030                 OR.B      #30H,D6         CONVERT UNITS DIGIT
0009FE 1086                      MOVE.B    D6,[A0]
000A00 41F9 0000                 LEA.L     CALMSG,A0       POINT TO CAL MESSAGE BUFFER
000A06 0839 0000                 BTST      #0,CALFLG       SEE IF STILL IN CAL MODE
000A0E 6600 0008                 BNE       CALEND          YES-DISPLAY CAL MSG
000A12 41F9 0000                 LEA.L     BOOMSG1,A0      ELSE DISPLAY BOOM MSG
000A18 6100 065E         CALEND  BSR       DSPMSG          DISPLAY CAL MESSAGE
000A1C 23FC                      MOVE.L    #00,CALSUM      RESET CAL. SUM
000A26 33FC 0FA0                 MOVE.W    #4000,CALTIM    RESET CAL. CLOCK
000A2E 6000 FE70                 BRA       TLOOP           RETURN TO WAIT LOOP

                         *
                         *****************************************************************
                         *
                         *   THIS ROUTINE CALCULATES THE SQUARE ROOT OF THE
                         *   VALUE IN D6 . THE RESULT IS RETURNED IN D6.REGISTERS
                         *   D5 AND D7 ARE USED FOR SCRATCH
                         *
                         *****************************************************************
                         *
000A32 2E06              SQRT    MOVE.L    D6,D7      SAVE INITIAL VALUE
000A34 E287              HLFLOP  ASR.L     #01,D7     HALVE THE VALUE
000A36 2A07                      MOVE.L    D7,D5
000A38 CAC5                      MULU      D5,D5      SQUARE THE HALF
000A3A BA86                      CMP.L     D6,D5      SEE IF CLOSE
000A3C 6EF6                      BGT       HLFLOP     IF NOT DO AGAIN
000A3E 0687              INCLOP  ADD.L     #01,D7     INCR. BACK UP
000A44 2A07                      MOVE.L    D7,D5      SAVE FOR SQUARE
000A46 CAC5                      MULU      D5,D5      SQUARE THE VALUE
000A48 BA86                      CMP.L     D6,D5      SEE IF SQRT MATCH
000A4A 6DF2                      BLT       INCLOP     IF NOT DO AGAIN
000A4C 4286                      CLR.L     D6
```

```
000A4E 3C07             MOVE.W   D7,D6      PUT SQUARE ROOT IN D6
000A50 4E75             RTS



                   *
                   ******************************************************************
                   *
                   *                           DAC
                   *
                   *    THIS IS THE A/D INTERRUPT SERVICE ROUTINE.AN INTERRUPT
                   *    WILL OCCUR EVERY 125 USEC. THE INPUT DATA IS EITHER
                   *    STORED IN BRAM IF IT IS AN EVENT OR AVERAGED BY CALLING
                   *    RAT. DAC ALSO MAINTAINS THE PEAK VALUE DURING AN EVENT
                   *    AND CHECKS FOR FALLING SLOPES TO ENABLE TIMER 2.
                   *
                   *    THE REGISTERS MAINTAINED BY DAC ARE :
                   *
                   *    D0 - NEWEST DATA         A0 - GENERAL USE
                   *    D1 - OLDEST DATA         A1 - BEGINNING OF EVENT (FLAG 1)
                   *    D2 - CURRENT PEAK        A2 - DOWN CROSSING (FLAG 2)
                   *    D3 - AVERAGE             A3 - CURRENT DATA POINT (FLAG 3)
                   *    D4 - MOVING TOTAL        A4 - PEAK VALUE POINTER (FLAG 4)
                   *    D5 - GENERAL USE         A5 - NEGITIVE PEAK POINTER
                   *    D6 -    "     "          A6 - OLDEST RAT VALUE POINTER
                   *    D7 -    "     "          A7 - STACK POINTER
                   *
                   *
                   *    TRIGR1 - POSITIVE PULSE TIME
                   *    TRIGR2 - SECOND JUMP VALUE
                   *    TRIGR3 - PEAK TRIGGER VALUE
                   *    TIMR1   - EVENT TIMER
                   *    TIMR2   - INTERVAL TIMER
                   *    TEST     - STATUS WORD
                   *
                   *              BIT 0       1 = RISING SLOPE   0 = FALLING SLOPE
                   *              BIT 1       1 = TIMER 1 ON     0 = TIMER 1 OFF
                   *              BIT 2       1 = TIMER 2 ON     0 = TIMER 2 OFF
                   *              BIT 3       1 = INITIALIZE RAT 0 = INIT. COMPLETE
                   *
                   *
                   ******************************************************************
                   *


000A52 4E71        DAC      NOP
000A54 48E7 0380            MOVEM.L  D6-D7/A0,-(A7) SAVE REGISTERS
000A58 4280                 CLR.L    D0
000A5A 3039 0001            MOVE.W   ADC,D0         GET A/D DATA

```

```
000A60 0839 0000   849          BTST      #0,CALFLG      CHECK FOR CAL. MODE
000A68 6700 0042   850          BEQ       DACCONT        IF NOT CONTINUE
000A6C 0C79 0000   851          CMP.W     #0,CALTIM      CHECK FOR END OF CAL PERIOD
000A74 6700 0222   852          BEQ       DACRET         IF YES RETURN
000A78 0479 0001   853          SUB.W     #1,CALTIM      ELSE DECR. PERIOD COUNTER
000A80 0839 0000   854          BTST      #0,ADSPFLG
000A88 6600 020E   855          BNE       DACRET
000A8C 4286        856          CLR.L     D6
000A8E 3C00        857          MOVE.W    D0,D6          GET A/D VALUE
000A90 0486        858          SUB.L     #8000H,D6      SUBTRACT A/D OFFSET
000A96 CDC6        859          MULS      D6,D6          SQUARE INPUT VALUE
000A98 8CFC 0FA0   860          DIVU      #4000,D6       DIVIDE BY NO. OF SAMPLES
000A9C 0286        861          AND.L     #0FFFFH,D6     MASK OFF REMAINDER
000AA2 DDB9 0000   862          ADD.L     D6,CALSUM      SUM RESULT
000AA8 6000 01EE   863          BRA       DACRET         RETURN
000AAC 0839 0003   864 DACCONT  BTST      #3,TEST        IS IT RAT INIT
000AB4 6600 01DC   865          BNE       AMBAVG         YES; GO AVERAGE DATA
000AB8 0C79 0001   866          CMPI.W    #01H,OFF       IF DISPLAY IS ON
000AC0 6700 01D6   867          BEQ       DACRET         RETURN
000AC4 B7C9        868          CMPA.L    A1,A3          FLAG1 = FLAG3 ?
000AC6 6700 013C   869          BEQ       AMBIENT        YES
000ACA D7FC        870 SAVEVT   ADDA.L    #2,A3          INCR. FLAG3
000AD0 3680        871          MOVE.W    D0,[A3]        STORE NEW DATA
000AD2 04B9        872          SUB.L     #1,EVNTCNT     DECR TIMER 1 COUNTER
000ADC 6600 001A   873          BNE       CONSAV         IF = 0; END EVENT
000AE0 2C0B        874          MOVE.L    A3,D6          SAVE CURRENT POINTER
000AE2 9C8C        875          SUB.L     A4,D6          SUB PEAK LOCATION
000AE4 0C86        876          CMP.L     #1600,D6       IS PEAK WITHIN 100 MS
000AEA 6C00 01DA   877          BGE       ENDBOOM        IF NO THEN END OF EVENT
000AEE 06B9        878          ADD.L     #800,EVNTCNT   ELSE ADD ANOTHER 100 MS
000AF8 0C79 0001   879 CONSAV   CMPI.W    #1,DATSAV
000B00 6700 0196   880          BEQ       DACRET
000B04 0839 0002   881          BTST      #2,TEST        IF TIMER 2 ACTIVE
000B0C 6700 0010   882          BEQ       CONEVNT
000B10 04B9        883          SUB.L     #1,T2CNT       DECREMENT TIMER COUNTER
000B1A 6700 01AA   884          BEQ       ENDBOOM        IF 0; END EVENT
000B1E B082        885 CONEVNT  CMP.L     D2,D0          NEW DATA > PEAK ?
000B20 6F00 0006   886          BLE       CHKNPK         NO
000B24 2400        887          MOVE.L    D0,D2          ELSE,RESET PEAK,AND
000B26 284B        888          MOVEA.L   A3,A4          RESET PEAK PNTR (FLAG4)
000B28 B0B9 0000   889 CHKNPK   CMP.L     NEGPK,D0       CHECK NEG. PEAK
000B2E 6E00 000A   890          BGT       GETSLOP
000B32 23C0 0000   891          MOVE.L    D0,NEGPK
000B38 2A4B        892          MOVEA.L   A3,A5
                   893
                   894
                   895
                   896
000B3A B081        897 GETSLOP  CMP.L     D1,D0          CHK NEW DATA WITH OLD
000B3C 6E00 0006   898          BGT       RISING         IF LARGER,RISING SLOPE
```

```
000B40 6D00 0070            BLT      FALLING        ELSE DECREASING SLOPE

                    *
                    *   SLOPE OF DATA IS RISING
                    *


000B44 08F9 0000    RISING  BSET     #0,TEST        SET SLOPE BIT TO RISING
000B4C B0B9 0000            CMP.L    TR2LOW,D0      IF NEW DATA < TRG LOW
000B52 6D00 0144            BLT      DACRET         RETURN
000B56 B0B9 0000            CMP.L    TR2HIGH,D0     IF NEW DATA > TRG HIGH
000B5C 6E00 0012            BGT      RISE1          CHECK IF T2 ACTIVE
000B60 0839 0002            BTST     #2,TEST        IF T2 NOT ACTIVE
000B68 6700 0082            BEQ      STRT2          START T 2
000B6C 6000 012A            BRA      DACRET         ELSE RETURN
000B70 0839 0002    RISE1   BTST     #2,TEST        IF T2 NOT ACTIVE
000B78 6700 011E            BEQ      DACRET         RETURN
000B7C B4B9 0000    RSTT2   CMP.L    TRIGR3H,D2     WAS LAST PEAK HIGH ENOUGH?
000B82 6E00 0022            BGT      RST2CON        YES-CONTINUE
000B86 2649                 MOVEA.L  A1,A3          ELSE RESET DATA POINTERS
000B88 D7FC                 ADDA.L   #2,A3
000B8E 3680                 MOVE.W   D0,[A3]
000B90 2400                 MOVE.L   D0,D2
000B92 284B                 MOVEA.L  A3,A4
000B94 2A4B                 MOVEA.L  A3,A5
000B96 23C0 0000            MOVE.L   D0,NEGPK
000B9C 23F9 0000            MOVE.L   TEMPT1,EVNTCNT
000BA6 08B9 0002    RST2CON BCLR     #2,TEST        ELSE RESET TIMER 2

                    *       TURN OFF TIMER 2


000BAE 6000 00E8            BRA      DACRET         RETURN

                    *
                    *   SLOPE OF DATA IS FALLING
                    *


000BB2 08B9 0000    FALLING BCLR     #0,TEST        SET SLOPE BIT TOFALLING
000BBA B0B9 0000            CMP.L    TR2HIGH,D0     IF NEW DATA > TRG HIGH
000BC0 6E00 00D6            BGT      DACRET         RETURN
000BC4 B0B9 0000            CMP.L    TR2LOW,D0      IF NEW DATA < TRG LOW
000BCA 6D00 0012            BLT      FALL1          CHECK IF T2 ACTIVE
000BCE 0839 0002            BTST     #2,TEST        IF T2 NOT ACTIVE
000BD6 6700 0014            BEQ      STRT2          START T2
000BDA 6000 00BC            BRA      DACRET         ELSE RETURN
000BDE 0839 0002    FALL1   BTST     #2,TEST        IF T2 NOT ACTIVE
000BE6 6700 00B0            BEQ      DACRET         RETURN
000BEA 6090                 BRA      RSTT2          ELSE RESET T2
```

```
000BEC 244B          949 STRT2    MOVEA.L   A3,A2          ELSE SET XING POINT (FLAG2)
000BEE 08F9 0002     950          BSET      #2,TEST        SET TIMER2 BIT ON
                     951
                     952 *        START TIMER 2
                     953
000BF6 23F9 0000     954          MOVE.L    TEMPT2,T2CNT
000C00 6000 0096     955          BRA       DACRET         RETURN
                     956
                     957 *
                     958 *      CHECK FOR START OF AN EVENT
                     959 *
                     960
                     961
000C04 4E71          962 AMBIENT  NOP
000C06 0C79 0001     963          CMPI.W    #1,DATSAV
000C0E 6700 001A     964          BEQ       NEWEVT
000C12 B0B9 0000     965          CMP.L     TR2HIGH,D0     NEW DATA > TRG HIGH
000C18 6E00 0010     966          BGT       NEWEVT         YES _ NEW EVENT
000C1C B0B9 0000     967          CMP.L     TR2LOW,D0      NEW DATA < TRG LOW
000C22 6D00 0006     968          BLT       NEWEVT         YES -NEW EVENT
000C26 6000 006A     969          BRA       AMBAVG         ELSE AVG NOISE
                     970
                     971 *
                     972 *      A NEW EVENT HAS BEEN DETECTED
                     973 *
                     974
                     975
000C2A 4E71          976 NEWEVT   NOP
000C2C 08B9 0000     977          BCLR      #0,BRAMON      TURN ON BAT. RAM
000C34 343C 0028     978          MOVE.W    #40,D2         SET DELAY COUNT
000C38 6100 047E     979          BSR       DELAY          DELAY 40 USEC.
                     980          *   START TIMER 1
                     981
000C3C 08F9 0001     982          BSET      #1,TEST        SET TIMER 1 STATUS ON
000C44 4286          983          CLR.L     D6
000C46 3C39 0000     984          MOVE.W    TIMR1,D6
000C4C CCFC 0010     985          MULU      #16,D6         SET UP COUNTER FOR TIMER1
000C50 0686          986          ADD.L     #160,D6
000C56 23C6 0000     987          MOVE.L    D6,TEMPT1
000C5C 23F9 0000     988          MOVE.L    TEMPT1,EVNTCNT
000C66 4286          989          CLR.L     D6
000C68 3C39 0000     990          MOVE.W    TIMR2,D6
000C6E 8CFC 0005     991          DIVU      #5,D6
000C72 CCFC 0008     992          MULU      #8,D6
000C76 23C6 0000     993          MOVE.L    D6,TEMPT2
000C7C D7FC          994          ADDA.L    #2,A3          INCR. FLAG3 (CUR. DATA)
000C82 3680          995          MOVE.W    D0,[A3]        STORE DATA POINT
000C84 2200          996          MOVE.L    D0,D1          STORE IN OLD DATA
000C86 2400          997          MOVE.L    D0,D2
000C88 23C0 0000     998          MOVE.L    D0,NEGPK
```

```
000C8E 6000 0008            BRA      DACRET         RETURN


             *
             *   NON EVENT SO JUST AVERAGE THE DATA
             *


000C92 6100 0052   AMBAVG   BSR      RAT            UPDATE AVG TABLE
000C96 2200                 MOVE.L   D0,D1          STORE NEW DATA IN OLD

             *
             *   RETURN FROM INTERRUPT
             *


000C98 4E71        DACRET   NOP
000C9A B7FC                 CMPA.L   #ENDBRM,A3     CHECK FOR END OF RAM
000CA0 6C00 0024            BGE      ENDBOOM        YES; EVALUATE LAST EVENT
000CA4 41F9 0002            LEA.L    PIA,A0
000CAA 1E39 0000            MOVE.B   PORTBC,D7      RESET A/D INTERRUPT
000CB0 08C7 0000            BSET     #0,D7
000CB4 0887 0001            BCLR     #1,D7
000CB8 1147 0007            MOVE.B   D7,BCNTL[A0]
000CBC 1E28 0005            MOVE.B   BDATA[A0],D7
000CC0 4CDF 01C0            MOVEM.L  [A7]+,D6-D7/A0  RESTORE REGISTERS
000CC4 4E73                 RTE

             *
             *    END OF EVENT DETECTED
             *


000CC6 4E71        ENDBOOM  NOP
000CC8 6100 14C2            BSR       TIMSUB        GO ANALYZE DATA
000CCC 60CA                 BRA       DACRET        RETURN

000CCE 4E71        RAMFL    NOP
000CD0 08F9 0000            BSET      #0,BRAMON     TURN OFF BAT. RAM
000CD8 41F9 0000            LEA.L     FULLMSG,A0    BRAM FULL MESSAGE DISPLAYED
000CDE 6100 0398            BSR       DSPMSG
000CE2 4E71        ENDLES   NOP
000CE4 60FC                 BRA       ENDLES        ENDLESS LOOP

             *
             *****************************************************************
             *
             *  RAT - THIS ROUTINE MAINTAINS A RUNNING AVERGE OF THE INPUT
             *        DATA . THIS AVERAGES OUT THE NOISE RECEIVED. THIS
             *        ROUTINE IS ONLY CALLED WHILE NO EVENT IS BEING
             *        RECORDED .
```

```
                   *
                   *   D0 - NEWEST DATA
                   *   D3 - AVERAGE              BOTRAT - BOTTOM OF RAT
                   *   D4 - MOVING TOTAL         A6 - OLDEST RAT VALUE POINTER
                   *
                   *
                   *   TRIGGER1 - FIRST JUMP VALUE (OFFSET)
                   *   SIZE1    - 1 SEC. SIZE BUFFER VAL
                   *   SIZE2    - 2 SEC. SIZE BUFFER VAL
                   *   SIZE3    - 4 SEC. SIZE BUFFER VAL
                   *   SIZE4    - 8 SEC. SIZE BUFFER VAL
                   *
                   *
                   *

                   ******************************************************************
                   *

000CE6 0C79 0002   RAT      CMPI.W   #2,PWRUP
000CEE 6E00 004A            BGT      PWRDEL
000CF2 4286                 CLR.L    D6
000CF4 3C16                 MOVE.W   (A6),D6
000CF6 9886                 SUB.L    D6,D4        SUM = SUM - OLD AVG.
000CF8 D880                 ADD.L    D0,D4          SUM = SUM + NEW DATA
000CFA 3C80                 MOVE.W   D0,(A6)        SAVE DATA IN RAT TABLE
000CFC 2604                 MOVE.L   D4,D3          MOVE IN SUM FOR DIVIDE
000CFE E083                 ASR.L    #8,D3          START THE DIVIDE
000D00 DDFC                 ADDA.L   #2,A6          INCR RAT POINTER
000D06 BDFC                 CMPA.L   #ENDRAT,A6      A6 > TOP OF RAT
000D0C 6F00 004C            BLE      ONESEC         NO GO TO SHIFTS
000D10 2C79 0000            MOVE.L   BOTRAT,A6          ELSE RESET RAT POINTER
000D16 0839 0003            BTST     #3,TEST        CHECK FOR PWR UP DELAY BIT
000D1E 6700 003A            BEQ      ONESEC         IF OFF CONTINUE
000D22 0479 0001            SUB.W    #1,PWRUP       DECR PWR UP DELAY COUNTER
000D2A 6600 002E            BNE      ONESEC
000D2E 08B9 0003            BCLR     #3,TEST        CLEAR RAT INIT STAT
000D36 6000 0022            BRA      ONESEC
000D3A 0479 0001   PWRDEL   SUBI.W   #1,PWRCNT
000D42 6600 0054            BNE      STOREND
000D46 0479 0001            SUBI.W   #1,PWRUP
000D4E 33FC 0FA0            MOVE.W   #4000,PWRCNT
000D56 6000 0040            BRA      STOREND


000D5A 0CB9        ONESEC   CMP.L    #SIZE1,BOTRAT   1 SEC. AVG. ?
000D64 6600 0008            BNE      TWOSEC         NO,CHECK NEXT
000D68 E883                 ASR.L    #04,D3         SHIFT
000D6A 6000 002C            BRA      STOREND        EXIT

000D6E 0CB9        TWOSEC   CMP.L    #SIZE2,BOTRAT   2 SEC. AVG ?
```

```
000D78 6600 0008              BNE       FOURSEC        NO,CHECK NEXT
000D7C EC83                   ASR.L     #06,D3         SHIFT
000D7E 6000 0018              BRA       STOREND        EXIT

000D82 0CB9          FOURSEC  CMP.L     #SIZE3,BOTRAT   4 SEC. AVG ?
000D8C 6600 0008              BNE       EIGHTSEC       NO,CHECK NEXT
000D90 EC83                   ASR.L     #06,D3         SHIFT
000D92 6000 0004              BRA       STOREND        EXIT

000D96 EE83          EIGHTSEC ASR.L     #07,D3         MUST BE 8 SEC. AVG.

000D98 4E71          STOREND  NOP
000D9A 4E75                   RTS                      RETURN


                     *
                     ****************************************************************
                     *
                     *     THIS IS WHERE THE REAL TIME CLOCK IS SET. THE TIME DATA
                     *     IS CONTAINED IN THE ARRAY SEC1 WITH THE ADDRESS BYTES
                     *     IN CLKTB. THE TIME IS OUTPUT 1 BYTE AT A TIME WITH THE
                     *     DATA IN THE LOW NIBBLE AND THE ADDRESS IN THE HIGH
                     *     NIBBLE. THE TIME IS OUTPUT IN THE ORDER SS,MM,HH,DD,MM,YY.
                     *
                     ****************************************************************
                     *

000D9C 48E7 E0F0     WRTCLK   MOVEM.L   D0-D2/A0-A3,-[A7]
000DA0 41F9 0002              LEA.L     PIA,A0         GET I/O PORT ADDRESS
000DA6 08B9 0002              BCLR.B    #2,PORTBC      MAKE IT A DIR. PORT
000DAE 1179 0000              MOVE.B    PORTBC,BCNTL[A0] OUTPUT DIRECTION
000DB6 117C 00FF              MOVE.B    #0FFH,BDDR[A0] MAKE ALL BITS OUTPUT
000DBC 0039 000C              OR.B      #0CH,PORTBC
000DC4 1179 0000              MOVE.B    PORTBC,BCNTL[A0]
000DCC 117C 0020              MOVE.B    #HOLD,ADATA[A0] HOLD CLOCK
000DD2 45F9 0000              LEA.L     SEC1,A2         GET TIMER TABLE
000DD8 47F9 0000              LEA.L     CLKTB,A3       GET TIMER CONTROL WORDS
000DDE 7E05                   MOVEQ     #5,D7          SET COUNTER
000DE0 0039 0080              OR.B      #80H,HOUR1     SET FOUR 24 HOUR CLOCK
000DE8 1012          WRTCLK1  MOVE.B    [A2],D0        GET TIME VALUE
000DEA 0200 000F              AND.B     #0FH,D0        GET LOWER NIBBLE
000DEE 801B                   OR.B      [A3]+,D0       STICK ON CONTROL BITS
000DF0 6100 0052              BSR       WRITEC         GO OUTPUT VALUE
000DF4 101A                   MOVE.B    [A2]+,D0       GET VALUE AGAIN
000DF6 E808                   LSR.B     #4,D0          SHIFT DOWN UPPER NIBBLE
000DF8 801B                   OR.B      [A3]+,D0       STICK ON CONTROL
000DFA 6100 0048              BSR       WRITEC         GO OUTPUT VALUE
000DFE 51CF FFE8              DBRA      D7,WRTCLK1     IF MORE,DO IT AGAIN
000E02 08B9 0002              BCLR      #2,PORTBC      MAKE IT A DIR PORT
000E0A 1179 0000              MOVE.B    PORTBC,BCNTL[A0] OUTPUT CNTROL
```

```
000E12 117C 00F0            MOVE.B    #0F0H,BDDR[A0] SET DATA FOR OUTPUT
000E18 08F9 0002            BSET.B    #2,PORTBC      MAKE IT A DATA PORT
000E20 08B9 0003            BCLR.B    #3,PORTBC
000E28 117C 0000            MOVE.B    #0,ADATA[A0]   ZERO DATA
000E2E 1179 0000            MOVE.B    PORTBC,BCNTL[A0]
000E36 0239 003F            AND.B     #3FH,HOUR1     RESET 24 HOUR BIT
000E3E 4CDF 0F07            MOVEM.L   [A7]+,D0-D2/A0-A3
000E42 4E75                 RTS


000E44 243C         WRITEC  MOVE.L    #500,D2
000E4A 6100 026C            BSR       DELAY
000E4E 1140 0005            MOVE.B    D0,BDATA[A0]
000E52 243C                 MOVE.L    #100,D2
000E58 6100 025E            BSR       DELAY
000E5C 117C 00A0            MOVE.B    #WRITE,ADATA[A0]
000E62 243C                 MOVE.L    #6,D2
000E68 6100 024E            BSR       DELAY
000E6C 117C 0020            MOVE.B    #HOLD,ADATA[A0]
000E72 4E75                 RTS


                    *
                    ****************************************************************
                    *
                    *   THIS SECTION READS THE CURRENT TIME FROM THE REAL TIME CLOCK.
                    *   THE TIME DATA READ IS STORED IN CLK1,CLK2,CLK3,AND THE DISPLAY
                    *   BUFFER AKDATA.TO READ THE TIME, THE ADDRESS BYTE IN CLKTB
                    *   IS OUTPUT AND THEN THE CORRESPONDING TIME VALUE IS READ. THE
                    *   TIME IS READ IN THE ORDER OF : SEC,MIN,HOUR,DAY,MONTH,YEAR.
                    *
                    ****************************************************************
                    *


000E74 48E7 E0F0    RDCLK   MOVEM.L   D0-D2/A0-A3,-[A7]
000E78 41F9 0002            LEA.L     PIA,A0         GET I/O PORT ADDRESS
000E7E 08F9 0003            BSET.B    #3,PORTBC
000E86 1179 0000            MOVE.B    PORTBC,BCNTL[A0]  OUTPUT CONTROL
000E8E 117C 0020            MOVE.B    #HOLD,ADATA[A0]   HOLD RTC
000E94 45F9 0000            LEA.L     SEC1,A2        GET TOP OF TIMER TABLE
000E9A 47F9 0000            LEA.L     CLKTB,A3       GET ADDRESS TABLE FOR RTC
000EA0 7E05                 MOVEQ     #5,D7          SET COUNT FOR SIX PARAMETERS
000EA2 343C 0064            MOVE.W    #100,D2        DELAY 100 USEC.
000EA6 6100 0210            BSR       DELAY
000EAA 4246         RDCLK1  CLR       D6
000EAC 101B                 MOVE.B    [A3]+,D0       PUT ADDRESS IN D0
000EAE 6100 0140            BSR       READC          GET TIMER VALUE
000EB2 1C00                 MOVE.B    D0,D6          SAVE PARAMETER
000EB4 101B                 MOVE.B    [A3]+,D0       GET NEXT LOWER NIBBLE ADDRESS
```

```
000EB6 6100 0138   1199          BSR       READC          GET VALUE
000EBA E948        1200          LSL       #4,D0          SHIFT INTO HIGH NIBBLE
000EBC 8C00        1201          OR.B      D0,D6          COMBINE WITH LOW NIBBLE
000EBE 14C6        1202          MOVE.B    D6,[A2]+       SAVE IN TABLE
000EC0 51CF FFE8   1203          DBRA      D7,RDCLK1      CONTINUE FOR SIX TIMES
000EC4 117C 0000   1204          MOVE.B    #0,ADATA[A0]   TURN OFF HOLD
000ECA 08B9 0003   1205          BCLR.B    #3,PORTBC
000ED2 1179 0000   1206          MOVE.B    PORTBC,BCNTL[A0] OUTPUT CONTROL
000EDA 41F9 0000   1207          LEA.L     SEC1,A0         GET TOP OF TIMER TABLE
000EE0 43F9 0000   1208          LEA.L     CLK1,A1
000EE6 0239 003F   1209          AND.B     #3FH,HOUR1     RESET 24 HOUR BIT
000EEE 343C 0002   1210          MOVE.W    #2,D2          SET COUTER FOR 3 PARAMETERS
000EF2 1018        1211 COMBIN   MOVE.B    [A0]+,D0       GET FIRST VALUE
000EF4 1218        1212          MOVE.B    [A0]+,D1       GET SECOND VALUE
000EF6 0240 00FF   1213          AND.W     #00FFH,D0      MASK OFF EXTRA BITS
000EFA 0241 00FF   1214          AND.W     #00FFH,D1      MASK OFF EXTRA BITS
000EFE E149        1215          LSL.W     #8,D1          MOVE TO HIGH BYTE
000F00 8041        1216          OR.W      D1,D0          COMBINE THE VALUES
000F02 32C0        1217          MOVE.W    D0,[A1]+       STORE IN CLK TABLE
000F04 51CA FFEC   1218          DBRA      D2,COMBIN
000F08 4280        1219          CLR.L     D0
000F0A 43F9 0000   1220          LEA.L     AKDATA,A1      UPDATE DISPLAY ARRAY
000F10 1039 0000   1221          MOVE.B    YEAR1,D0
                   1222 *
                   1223 *  THIS CODE GETS EACH DIGIT OF THE TIME & DATE AND
                   1224 *  CONVERTS IT TO ASCII BEFORE STORING IT INTO THE
                   1225 *  DISPLAY ARRAY AKDATA.
                   1226 *
000F16 E808        1227          LSR.B     #4,D0 000F18 0200 000F   1228         AND.B     #0FH,D0
000F1C 0000 0030   1229          OR.B      #30H,D0
000F20 12C0        1230          MOVE.B    D0,[A1]+
000F22 1039 0000   1231          MOVE.B    YEAR1,D0
000F28 0200 000F   1232          AND.B     #0FH,D0
000F2C 0000 0030   1233          OR.B      #30H,D0
000F30 12C0        1234          MOVE.B    D0,[A1]+
000F32 1039 0000   1235          MOVE.B    MONTH1,D0
000F38 E808        1236          LSR.B     #4,D0
000F3A 0200 000F   1237          AND.B     #0FH,D0
000F3E 0000 0030   1238          OR.B      #30H,D0
000F42 12C0        1239          MOVE.B    D0,[A1]+
000F44 1039 0000   1240          MOVE.B    MONTH1,D0
000F4A 0200 000F   1241          AND.B     #0FH,D0
000F4E 0000 0030   1242          OR.B      #30H,D0
000F52 12C0        1243          MOVE.B    D0,[A1]+
000F54 1039 0000   1244          MOVE.B    DAY1,D0
000F5A E808        1245          LSR.B     #4,D0
000F5C 0200 000F   1246          AND.B     #0FH,D0
000F60 0000 0030   1247          OR.B      #30H,D0
000F64 12C0        1248          MOVE.B    D0,[A1]+
000F66 1039 0000   1249          MOVE.B    DAY1,D0 000F6C 0200 000F   1250         AND.B     #0FH,D0
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```
000F70 0000 0030   1251          OR.B      #30H,D0
000F74 12C0        1252          MOVE.B    D0,[A1]+
000F76 12FC 002E   1253          MOVE.B    #2EH,[A1]+
000F7A 1039 0000   1254          MOVE.B    HOUR1,D0
000F80 E808        1255          LSR.B     #4,D0
000F82 0200 000F   1256          AND.B     #0FH,D0
000F86 0000 0030   1257          OR.B      #30H,D0
000F8A 12C0        1258          MOVE.B    D0,[A1]+
000F8C 1039 0000   1259          MOVE.B    HOUR1,D0
000F92 0200 000F   1260          AND.B     #0FH,D0
000F96 0000 0030   1261          OR.B      #30H,D0
000F9A 12C0        1262          MOVE.B    D0,[A1]+
000F9C 12FC 002E   1263          MOVE.B    #2EH,[A1]+
000FA0 1039 0000   1264          MOVE.B    MIN1,D0
000FA6 E808        1265          LSR B     #4,D0
000FA8 0200 000F   1266          AND.B     #0FH,D0
000FAC 0000 0030   1267          OR.B      #30H,D0
000FB0 12C0        1268          MOVE.B    D0,[A1]+
000FB2 1039 0000   1269          MOVE.B    MIN1,D0
000FB8 0200 000F   1270          AND.B     #0FH,D0
000FBC 0000 0030   1271          OR.B      #30H,D0
000FC0 12C0        1272          MOVE.B    D0,[A1]+
000FC2 4280        1273          CLR.L     D0
000FC4 12FC 002E   1274          MOVE.B    #2EH,[A1]+
000FC8 1039 0000   1275          MOVE.B    SEC1,D0
000FCE E808        1276          LSR.B     #4,D0
000FD0 0200 000F   1277          AND.B     #0FH,D0
000FD4 0000 0030   1278          OR.B      #30H,D0
000FD8 12C0        1279          MOVE.B    D0,[A1]+
000FDA 1039 0000   1280          MOVE.B    SEC1,D0
000FE0 0200 000F   1281          AND.B     #0FH,D0
000FE4 0000 0030   1282          OR.B      #30H,D0
000FE8 12C0        1283          MOVE.B    D0,[A1]+
000FEA 4CDF 0F07   1284          MOVEM.L   [A7]+,D0-D2/A0-A3
000FEE 4E75        1285          RTS
000FF0 1140 0005   1286 READC    MOVE.B    D0,BDATA[A0]   OUTPUT ADDRESS
000FF4 117C 0060   1287          MOVE.B    #READ,ADATA[A0] OUTPUT READ COMMAND
000FFA 343C 0006   1288          MOVE.W    #6,D2 000FFE 6100 00B8   1289          BSR       DELAY
001002 1028 0005   1290          MOVE.B    BDATA[A0],D0   GET DATA
001006 0200 000F   1291          AND.B     #0FH,D0        MASK OFF EXTRA BITS
00100A 117C 0020   1292          MOVE.B    #HOLD,ADATA[A0] HOLD CLOCK
001010 4E75        1293          RTS
                   1294
                   1295
                   1296 *
                   1297 *    MEMORY DIAGNOSTIC ERROR ROUTINE
                   1298 *    THIS ROUTINE DISPLAYS THE APPROPRIATE ERROR DETERMINED
                   1299 *    BY THE BITS SET IN D7.
                   1300 *    BIT 0 - ROM CHECK SUM ERROR
                   1301 *    BIT 1 _ STATIC RAM ERROR
```

```
                    *    BIT 2 - BATTERY RAM ERROR
                    *

001012 08F9 0000    MEMERR   BSET      #0,BRAMON      TURN OFF BAT. RAM
00101A 48E7 0100             MOVEM.L   D7,-[A7]       SAVE D7 DIAGNOSTICS STATUS
00101E 6100 1126             BSR       INITDS         INITIALIZE DISPLAY
001022 4CDF 0080             MOVEM.L   [A7]+,D7
001026 0807 0000             BTST      #0,D7          CHECK FOR ROM ERROR
00102A 6700 000C             BEQ       MEM1
00102E 41F9 0000             LEA.L     ROMMSG,A0      GET ROM MESSAGE
001034 6000 001A             BRA       MEMSG
001038 0807 0001    MEM1     BTST      #1,D7          CHECK FOR RAM ERROR
00103C 6700 000C             BEQ       MEM2
001040 41F9 0000             LEA.L     SRAMSG,A0      GET RAM ERROR MESSAGE
001046 6000 0008             BRA       MEMSG
00104A 41F9 0000    MEM2     LEA.L     BRAMSG,A0      MUST BE RAT OR BATTERY ERROR
001050 13FC 0000    MEMSG    MOVE.B    #00,DSPADR     SET UP START ADDRESS POINTER
001058 7C0F                  MOVEQ     #15,D6         INIT CHARACTER COUNT
00105A 1E18         MEM3LP   MOVE.B    [A0]+,D7       GET DATA BYTE
00105C E14F                  LSL       #8,D7
00105E 1E39 0000             MOVE.B    DSPADR,D7      GET ADDRESS BYTE
001064 6100 1034             BSR       WRDISP         GO WRITE DATA TO DISPLAY
001068 0639 0001             ADD.B     #1,DSPADR      INCR. INDEX
001070 51CE FFE8             DBRA      D6,MEM3LP      DECR. CHARACTER COUNT
001074 4E71         MEMSTP   NOP
001076 60FC                  BRA       MEMSTP
                    *
                    *******************************************************************
                    *
                    *   THIS ROUTINE DISPLAYS THE MESSAGE POINTED TO
                    *   BY A0 ONTO THE DISPLAY
                    *
                    *******************************************************************
                    *

001078 0C79 0000    DSPMSG   CMPI.W    #00,BOOMFLG   IF NOT IN AN EVENT
001080 6700 0010             BEQ       DSPCONT        CONTINUE
001084 0C79 0001             CMPI.W    #01,OFF        IF DISPLAY OFF - EXIT
00108C 6700 0004             BEQ       DSPCONT
001090 4E75                  RTS
001092 13FC 0000    DSPCONT  MOVE.B    #00,DSPADR     SET UP START ADDRESS POINTER
00109A 7C0F                  MOVEQ     #15,D6         INIT CHARACTER COUNT
00109C 1E18         DSPMLP   MOVE.B    [A0]+,D7       GET DATA BYTE
00109E E14F                  LSL       #8,D7
0010A0 1E39 0000             MOVE.B    DSPADR,D7      GET ADDRESS BYTE
0010A6 6100 0FF2             BSR       WRDISP         GO WRITE DATA TO DISPLAY
0010AA 0639 0001             ADD.B     #1,DSPADR      INCR. INDEX
0010B2 51CE FFE8             DBRA      D6,DSPMLP      DECR. CHARACTER COUNT
0010B6 4E75                  RTS

```

```
                  *****************************************************************
                  *
                  *    DELAY ROUTINE - USE THE VALUE IN D2 TO COUNT
                  *    THE CONTENTS OF D2 CONTAINS THE NUMBER OF USEC'S TO DELAY.
                  *
                  ******************************************************************

0010B8 51CA FFFE  DELAY   DBRA     D2,DELAY
0010BC 4E75               RTS


0010BE 4E73       BUSERR  RTE                       BUS ERROR INTERRUPT
0010C0 4E73       ADDERR  RTE                       ADDRESS ERROR INTERRUPT


                  ;:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                  ;       ROUTINE 'KEYPAD'                                      :
                  ;                                                             :
                  ; This routine services a keypad interrupt,parses the user    :
                  ; and provides user interface.                                :
                  ; All function keys are serviced and numeric input            :
                  ; decoded and stored. Written in 68000 assembler using HP64000 :
                  ;                                                             :
                  ;:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

0010C2 4E71       KEYPD   NOP
0010C4 48E7 FFFE          MOVEM.L  D0-D7/A0-A6,-[A7]
0010C8 23C9 0000          MOVE.L   A1,CURPNT        SAVE CURRENT DATA POINTER
0010CE 33C3 0000          MOVE.W   D3,CURAVG
0010D4 4EB9 0000          JSR     GETKEY              GET USER INPUT
0010DA 0C79 00FF          CMPI.W  #0FFH,KEY           OFF OR ON REQUEST?
0010E2 6700 00E0          BEQ     OFFON
0010E6 0C79 0001          CMPI.W  #01H,OFF            IF NOT, IS DISPLAY ON?
0010EE 6700 0012          BEQ     BRAFTN              YES, MOVE TO APPROPRAITE FUNCTION
0010F2 0C79 00CC          CMPI.W  #0CCH,KEY
0010FA 6700 0068          BEQ     TOGDSP
0010FE 6000 0FCC          BRA     KEYRET              NO, WAIT TO RECEIVE A DSPON CMD

                  ;:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                  ; INPUT FOR KEYS 'A' THROUGH 'F' HAVE BEEN CODED INTO VARIABLE
                  ; 'FUNCT' USING A - F (HEX) VALUES.  CHECK TO SEE WHICH FUNCTION
                  ; WAS SELECTED, THEN MOVE TO THAT ROUTINE.
                  ;:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

001102 0C79 0000  BRAFTN  CMPI.W  #00H,FUNCT          FUNCTION ACTIVE?
00110A 6700 0088          BEQ     GETFTN              IF NOT, CONVERT INPUT
00110E 0C79 000A          CMPI.W  #0AH,FUNCT          A - TIME AND DATE
001116 6700 01B8          BEQ     AKEY
00111A 0C79 000B          CMPI.W  #0BH,FUNCT          B - STATISTICAL INFO
001122 6700 0578          BEQ     BKEY
```

```
001126 0C79 000C           CMPI.W  #0CH,FUNCT       C - CALIBRATION
00112E 6700 0916           BEQ     CKEY
001132 0C79 000D           CMPI.W  #0DH,FUNCT       D - SOFT VALUES
00113A 6700 0990           BEQ     DKEY
00113E 0C79 000E           CMPI.W  #0EH,FUNCT       E - MEMORY LEFT
001146 6700 0E36           BEQ     EKEY
00114A 0C79 000F           CMPI.W  #0FH,FUNCT       F - DATA SAVE
001152 6700 0EA0           BEQ     FKEY
001156 33FC 0002    BADFTN MOVE.W  #2H,ERRNUM       'SELECT FUNCTION'
00115E 4EF9 0000           JMP     ERROR


001164 0C79 0000    TOGDSP CMPI.W  #0,BOOMFLG      CHECK FOR DISPLAY BLANKING
00116C 6700 0016           BEQ     BOOMON
001170 4279 0000           CLR.W   BOOMFLG
001176 41F9 0000           LEA.L   BOOMSG1,A0
00117C 6100 FEFA           BSR     DSPMSG
001180 6000 0F4A           BRA     KEYRET
001184 33FC 00FF    BOOMON MOVE.W  #0FFH,BOOMFLG
00118C 6100 0FB8           BSR     INITDS
001190 6000 0F3A           BRA     KEYRET

                    ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                    ;  INPUT IS EITHER USER FUNCTION A-F, A COMMAND TO CLEAR,
                    ;  ON/OFF, OR IS AN ERROR.  SET FUNCTION CODE OR BRANCH TO
                    ;  APPROPRIATE ROUTINE.
                    ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

001194 0C79 0001    GETFTN CMPI.W  #1H,ALPHA        WAS LETTER INPUT?
00119C 6600 0010           BNE     NOTFTN           IF NOT, CHECK COMMANDS
0011A0 33F9 0000           MOVE.W  KEY,FUNCT        IF SO, SET FUNCTION CODE
0011AA 4EF8 1102           JMP     BRAFTN           ...FIND FUNCTION ROUTINE
0011AE 0C79 00CC    NOTFTN CMPI.W  #0CCH,KEY        WAS 'CLEAR' INPUT?
0011B6 6600 0068           BNE     ERROR            'KEY ENTRY ERROR'
0011BA 6100 0F8A           BSR     INITDS           CLEAR DISPLAY
0011BE 4EF9 0000           JMP     KEYRET

                    ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                    ; TURNS DISPLAY OFF OR ON.
                    ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

0011C4 33FC 0000    OFFON  MOVE.W  #00H,FUNCT       CLEAR FUNCTION FLAG
0011CC 33FC 0000           MOVE.W  #00H,COUNT       CLEAR KEY COUNT
0011D4 13FC 0000           MOVE.B  #00H,DSPADR      RESET DISPLAY ADDR
0011DC 6100 0F68           BSR     INITDS           CLEAR DISPLAY
0011E0 0C79 0000           CMPI.W  #00H,OFF         IS DISPLAY OFF?
0011E8 6700 0028           BEQ     DSPON            IF SO, TURN IT ON

0011EC 33FC 0000    DSPOFF MOVE.W  #00H,OFF         TURN DISPLAY OFF
0011F4 08B9 0000           BCLR    #0,CALFLG        CLEAR CALIBRATION FLAG
```

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0011FC 4279 0000            CLR.W    ADSPFLG          CLEAR CAL 2 FLAG
001202 41F9 0000            LEA.L    BOOMSG1,A0
001208 6100 FE6E            BSR      DSPMSG
00120C 4EF9 0000            JMP      KEYRET

001212 33FC 0001   DSPON    MOVE.W   #01H,OFF         TURN DISPLAY ON
00121A 4EF9 0000            JMP      KEYRET
                   ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                   ; ERROR SUBROUTINE PRINTS ERROR MESSAGE TO DISPLAY, DELAYS 3
                   ; SECONDS, CLEARS VARIABLES, THEN RETURNS.
                   ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

001220 4E71        ERROR    NOP
001222 3439 0000            MOVE.W   ERRNUM,D2        ERROR # INTO D2
001228 E94A                 LSL      #4,D2            MULTIPLY BY 16
00122A 41F9 0000            LEA.L    ERRMSG,A0        ERROR MESSAGE BASE ADDR
001230 D0C2                 ADDA     D2,A0            ADDRESSES CORRECT ERR MSG
001232 33FC 0000            MOVE.W   #00,ERRNuM       CLEAR ERRNUM
00123A 6100 FE3C            BSR      DSPMSG
00123E 0C79 000A            CMPI.W   #0AH,FUNCT       IS FUNCTION A ON?
001246 6600 0016            BNE      TRYB
00124A 720B                 MOVEQ    #11,D1           12 WORDS TO CLEAR
00124C 45F9 0000            LEA.L    HIYR,A2          START CLEARING AT HIYR
001252 34FC 0000   CLEARA   MOVE.W   #00H,(A2)+       ZERO OUT BUFFERS
001256 51C9 FFFA            DBRA     D1,CLEARA
00125A 6000 003E            BRA      NONERON
00125E 0C79 000B   TRYB     CMPI.W   #0BH,FUNCT       IS FUNCTION B ON?
001266 6600 0016            BNE      TRYD
00126A 7207                 MOVEQ    #7,D1            8 WORDS TO CLEAR
00126C 45F9 0000            LEA.L    HITT,A2          START CLEARING AT HITT
001272 34FC 0000   CLEARB   MOVE.W   #00H,(A2)+       ZERO OUT BUFFERS
001276 51C9 FFFA            DBRA     D1,CLEARB
00127A 6000 001E            BRA      NONERON
00127E 0C79 000D   TRYD     CMPI.W   #0DH,FUNCT       IS FUNCTION D ON?
001286 6600 0012            BNE      NONERON          NO FUNCTIONS ARE ON
00128A 720B                 MOVEQ    #11,D1           12 WORDS TO CLEAR
00128C 45F9 0000            LEA.L    HITR3,A2         START CLEARING AT HITR3
001292 34FC 0000   CLEARD   MOVE.W   #00H,(A2)+       ZERO OUT BUFFERS
001296 51C9 FFFA            DBRA     D1,CLEARD
00129A 33FC 0000   NONERON  MOVE.W   #00H,FUNCT       CLEAR FUNCTION FLAG
0012A2 33FC 00FF            MOVE.W   #0FFH,KEY        CLEAR KEY
0012AA 33FC 0000            MOVE.W   #00H,ALPHA       CLEAR ALPHA FLAG
0012B2 33FC 0000            MOVE.W   #00H,COUNT       CLEAR KEY COUNT
0012BA 13FC 0000            MOVE.B   #00H,DSPADR      RESET DISPLAY ADDR
0012C2 33FC 0000            MOVE.W   #00H,POINT       CLEAR DECIMAL POINT
0012CA 4EF9 0000            JMP      KEYRET

                   ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
                   ;  AKEY    -    KEY SERVICE ROUTINE FOR DATE AND TIME
                   ;
                   ;  FORMATTING OF DATA IS AS FOLLOWS:
                   ;
                   ;        <on> <A> <enter> YYMMDD.HH.MM.SS <enter>
                   ;
                   ;         WHERE YY REPRESENT THE FIRST AND SECOND DIGITS OF
                   ;         THE CURRENT YEAR, MM LIKEWISE REPRESENTS THE MONTH,
                   ;         DD THE DAY, HH THE HOUR, MM THE MINUTES, AND SS THE
                   ;         SECONDS.  VALID ENTRIES FOR THESE NUMBERS ARE ANY
                   ;         VALID DATE AND TIME.
                   ;;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

0012D0 0679 0001   AKEY     ADDI.W   #1H,COUNT          INCREMENT KEYSTROKE COUNT
0012D8 0C79 00CC            CMPI.W   #0CCH,KEY          CLEAR COMMAND?
0012E0 6700 0270            BEQ      ACLEAR
0012E4 0C79 0001            CMPI.W   #1H,COUNT          FIRST KEY?
0012EC 6700 0268            BEQ      ISTIME             IF SO, DISPLAY TIME
0012F0 0C79 0002            CMPI.W   #2H,COUNT          SECOND KEY?
0012F8 6700 003E            BEQ      AENT               SHOULD BE 'ENTER'
0012FC 0C79 0009            CMPI.W   #9H,COUNT          POINT FOLLOWS DAY
001304 6700 0D0E            BEQ      DECPTS
001308 0C79 000C            CMPI.W   #0CH,COUNT         POINT FOLLOWS HRS
001310 6700 0D02            BEQ      DECPTS
001314 0C79 000F            CMPI.W   #0FH,COUNT         POINT FOLLOWS MINUTES
00131C 6700 0CF6            BEQ      DECPTS
001320 0C79 0012            CMPI.W   #12H,COUNT         SHOULD BE AN 'ENTER'
001328 6600 0024            BNE      ISDIGA
00132C 0C79 00EE            CMPI.W   #0EEH,KEY          'ENTER' COMMAND
001334 6700 023E            BEQ      AENTER

001338 0C79 00EE   AENT     CMPI.W   #0EEH,KEY
001340 6600 FEDE            BNE      ERROR              'KEY ENTRY ERROR'
001344 6100 0E00            BSR      INITDS
001348 4EF9 0000            JMP      KEYRET

                   ;;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   ;        ISDIGA   -     CHECKS FORMAT AND RANGE FOR INPUT
                   ;        5, 7, A, D, 10 AND 11 ARE SPECIAL CASES IN WHICH THE
                   ;        NUMBERS MUST NOT EXCEED PREDETERMINED VALUES.
                   ;;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

00134E 0C79 000A   ISDIGA   CMPI.W   #0AH,KEY           IS KEY > 10?
001356 6C00 FEC8            BGE      ERROR              'KEY ENTRY ERROR'
00135A 0C79 0005            CMPI.W   #05H,COUNT         IS 5TH KEY?
001362 6600 001A            BNE      CHKA7
001366 0C79 0002            CMPI.W   #2H,KEY            FIRST DIGIT OF MONTH
00136E 6D00 009E            BLT      SAVEA
001372 33FC 0003            MOVE.W   #3H,ERRNUM         'INVALID NUMBER'
00137A 4EF8 1220            JMP      ERROR

00137E 0C79 0007   CHKA7    CMPI.W   #07H,COUNT         7TH KEY?
```

```
001386 6600 001A   1553          BNE     CHKAA
00138A 0C79 0004   1554          CMPI.W  #04H,KEY          FIRST DIGIT OF DAY
001392 6D00 007A   1555          BLT     SAVEA
001396 33FC 0003   1556          MOVE.W  #3H,ERRNUM        'INVALID NUMBER'
00139E 4EF8 1220   1557          JMP     ERROR
                   1558
0013A2 0C79 000A   1559 CHKAA    CMPI.W  #0AH,COUNT        10TH KEY?
0013AA 6600 001A   1560          BNE     CHKAD
0013AE 0C79 0003   1561          CMPI.W  #03H,KEY          FIRST DIGIT OF HOURS
0013B6 6D00 0056   1562          BLT     SAVEA
0013BA 33FC 0003   1563          MOVE.W  #3H,ERRNUM        'INVALID NUMBER'
0013C2 4EF8 1220   1564          JMP     ERROR
                   1565
0013C6 0C79 000D   1566 CHKAD    CMPI.W  #0DH,COUNT        13TH KEY?
0013CE 6600 001A   1567          BNE     CHKA10
0013D2 0C79 0006   1568          CMPI.W  #06H,KEY          FIRST DIGIT OF MINUTES
0013DA 6D00 0032   1569          BLT     SAVEA
0013DE 33FC 0003   1570          MOVE.W  #3H,ERRNUM        'INVALID NUMBER'
0013E6 4EF8 1220   1571          JMP     ERROR
                   1572
0013EA 0C79 0010   1573 CHKA10   CMPI.W  #10H,COUNT        16TH KEY?
0013F2 6600 001A   1574          BNE     SAVEA
0013F6 0C79 0006   1575          CMPI.W  #6H,KEY           FIRST DIGIT OF SECONDS
0013FE 6D00 000E   1576          BLT     SAVEA
001402 33FC 0003   1577          MOVE.W  #3H,ERRNUM        ONLY ZERO INPUT FOR SECS
00140A 4EF8 1220   1578          JMP     ERROR
                   1579
                   1580
                   1581 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1582 ;        SAVEA    -      STORES INPUT DIGIT FOR FUTURE USE
                   1583 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1584
00140E 0C79 0003   1585 SAVEA    CMPI.W  #3H,COUNT
001416 6600 0012   1586          BNE     A04
00141A 33F9 0000   1587          MOVE.W  KEY,HIYR          SAVE FIRST DIG OF YEAR
001424 4EF9 0000   1588          JMP     PUTKEY            WRITE TO DISPLAY
00142A 0C79 0004   1589 A04      CMPI.W  #04H,COUNT
001432 6600 0012   1590          BNE     A05
001436 33F9 0000   1591          MOVE.W  KEY,LOYR          SAVE SECOND DIG OF YEAR
001440 4EF9 0000   1592          JMP     PUTKEY            WRITE TO DISPLAY
001446 0C79 0005   1593 A05      CMPI.W  #05H,COUNT
00144E 6600 0012   1594          BNE     A06
001452 33F9 0000   1595          MOVE.W  KEY,HIMO          SAVE FIRST DIG OF MONTH
00145C 4EF9 0000   1596          JMP     PUTKEY            WRITE TO DISPLAY
001462 0C79 0006   1597 A06      CMPI.W  #06H,COUNT
00146A 6600 0012   1598          BNE     A07
00146E 33F9 0000   1599          MOVE.W  KEY,LOMO          SAVE SECOND DIG OF MONTH
001478 4EF9 0000   1600          JMP     PUTKEY            WRITE TO DISPLAY
00147E 0C79 0007   1601 A07      CMPI.W  #07H,COUNT
001486 6600 0012   1602          BNE     A08
```

```
00148A 33F9 0000   1603          MOVE.W   KEY,HIDA          SAVE FIRST DIG OF DAY
001494 4EF9 0000   1604          JMP      PUTKEY            WRITE TO DISPLAY
00149A 0C79 0008   1605 A08      CMPI.W   #08H,COUNT
0014A2 6600 0012   1606          BNE      AA
0014A6 33F9 0000   1607          MOVE.W   KEY,LODA          SAVE SECOND DIG OF DAY
0014B0 4EF9 0000   1608          JMP      PUTKEY            WRITE TO DISPLAY
0014B6 0C79 000A   1609 AA       CMPI.W   #0AH,COUNT
0014BE 6600 0012   1610          BNE      AB
0014C2 33F9 0000   1611          MOVE.W   KEY,HIHR          SAVE FIRST DIG OF HOUR
0014CC 4EF9 0000   1612          JMP      PUTKEY            WRITE TO DISPLAY
0014D2 0C79 000B   1613 AB       CMPI.W   #0BH,COUNT
0014DA 6600 0012   1614          BNE      AD
0014DE 33F9 0000   1615          MOVE.W   KEY,LOHR          SAVE SECOND DIG OF HOUR
0014E8 4EF9 0000   1616          JMP      PUTKEY            WRITE TO DISPLAY
0014EE 0C79 000D   1617 AD       CMPI.W   #0DH,COUNT
0014F6 6600 0012   1618          BNE      AE
0014FA 33F9 0000   1619          MOVE.W   KEY,HIMN          SAVE FIRST DIG OF MINUTES
001504 4EF9 0000   1620          JMP      PUTKEY            WRITE TO DISPLAY
00150A 0C79 000E   1621 AE       CMPI.W   #0EH,COUNT
001512 6600 0012   1622          BNE      A10
001516 33F9 0000   1623          MOVE.W   KEY,LOMN          SAVE SECOND DIG OF MINUTES
001520 4EF9 0000   1624          JMP      PUTKEY            WRITE TO DISPLAY
001526 0C79 0010   1625 A10      CMPI.W   #10H,COUNT
00152E 6600 0012   1626          BNE      A11
001532 33F9 0000   1627          MOVE.W   KEY,HISC          SAVE FIRST DIGIT OF SECONDS
00153C 4EF9 0000   1628          JMP      PUTKEY            WRITE TO DISPLAY
001542 33F9 0000   1629 A11      MOVE.W   KEY,LOSC          SAVE SECOND DIG OF SECONDS
00154C 4EF9 0000   1630          JMP      PUTKEY            WRITE TO DISPLAY
                   1631
                   1632 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1633 ;  ACLEAR   -    CLEARS CURRENT DISPLAY
                   1634 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1635
001552 6100 0BF2   1636 ACLEAR   BSR        INITDS
                   1637
                   1638 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1639 ;  ISTIME   -    DISPLAYS WORKING VALUES FOR CURRENT TIME
                   1640 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1641
001556 4E71        1642 ISTIME   NOP
001558 6100 F91A   1643          BSR      RDCLK          GET CURRENT TIME AND DATE
00155C 41F9 0000   1644          LEA.L    AKDATA,A0
001562 6100 FB14   1645          BSR      DSPMSG
001566 13FC 0000   1646          MOVE.B   #00H,DSPADR       RESET DISPLAY ADDR
00156E 4EF9 0000   1647          JMP      KEYRET
                   1648
                   1649 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1650 ;  AENTER   -    STORES INPUT DATA IN SPECIFIC BUFFERS
                   1651 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1652
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001574 4E71           1653 AENTER  NOP
001576 45F9 0000      1654         LEA.L    HIYR,A2         ADDR OF DATA
00157C 47F9 0000      1655         LEA.L    YEAR,A3         ADDR OF ANSWERS
001582 4281           1656         CLR.L    D1
001584 321A           1657         MOVE.W   [A2]+,D1
001586 E949           1658         LSL.W    #4,D1
001588 825A           1659         OR.W     [A2]+,D1
00158A 36C1           1660         MOVE.W   D1,[A3]+
00158C 321A           1661         MOVE.W   [A2]+,D1
00158E E949           1662         LSL.W    #4,D1
001590 825A           1663         OR.W     [A2]+,D1
001592 36C1           1664         MOVE.W   D1,[A3]+
001594 321A           1665         MOVE.W   [A2]+,D1
001596 E949           1666         LSL.W    #4,D1
001598 825A           1667         OR.W     [A2]+,D1
00159A 36C1           1668         MOVE.W   D1,[A3]+
00159C 321A           1669         MOVE.W   [A2]+,D1
00159E E949           1670         LSL.W    #4,D1
0015A0 825A           1671         OR.W     [A2]+,D1
0015A2 36C1           1672         MOVE.W   D1,[A3]+
0015A4 321A           1673         MOVE.W   [A2]+,D1
0015A6 E949           1674         LSL.W    #4,D1
0015A8 825A           1675         OR.W     [A2]+,D1
0015AA 36C1           1676         MOVE.W   D1,[A3]+
0015AC 321A           1677         MOVE.W   [A2]+,D1
0015AE E949           1678         LSL.W    #4,D1
0015B0 825A           1679         OR.W     [A2]+,D1
0015B2 36C1           1680         MOVE.W   D1,[A3]+
0015B4 33FC 0000      1681         MOVE.W   #00H,FUNCT        NO FUNCT ACTIVE
0015BC 33FC 0000      1682         MOVE.W   #00H,COUNT        KEY COUNT CLEARED
0015C4 13FC 0000      1683         MOVE.B   #00H,DSPADR       RESET DISPLAY ADDR
0015CC 33FC 0000      1684         MOVE.W   #00H,ALPHA        CLEAR ALPHA FLAG
0015D4 33FC 0000      1685         MOVE.W   #00H,POINT        CLEAR DECIMAL POINT
0015DC 3239 0000      1686         MOVE.W    YEAR,D1        RE-INIT REAL TIME CLOCK
0015E2 13C1 0000      1687         MOVE.B   D1,YEAR1        WITH NEW TIME AND DATE
0015E8 3239 0000      1688         MOVE.W    MONTH,D1
0015EE 13C1 0000      1689         MOVE.B    D1,MONTH1
0015F4 3239 0000      1690         MOVE.W    DAY,D1
0015FA 13C1 0000      1691         MOVE.B    D1,DAY1
001600 3239 0000      1692         MOVE.W    HOUR,D1
001606 13C1 0000      1693         MOVE.B    D1,HOUR1
00160C 3239 0000      1694         MOVE.W    MINUTE,D1
001612 13C1 0000      1695         MOVE.B    D1,MIN1
001618 3239 0000      1696         MOVE.W    SECOND,D1
00161E 13C1 0000      1697         MOVE.B    D1,SEC1
001624 08B9 0000      1698         BCLR      #0,BRAMON        TURN ON BAT.  RAM
00162C 243C           1699         MOVE.L    #50,D2           SET FOR 50 USEC. DELAY
001632 6100 FA84      1700         BSR       DELAY            DELAY
001636 6100 F764      1701         BSR       WRTCLK
00163A 243C           1702         MOVE.L    #100,D2
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001640 6100 FA76               BSR      DELAY
001644 6100 F82E               BSR      RDCLK
001648 2679 0000               MOVE.L   CURPNT,A3      PUT NEW TIME IN BRAM
00164E D7FC                    ADD.L    #2,A3
001654 36F9 0000               MOVE.W   CLK1,[A3]+
00165A 36F9 0000               MOVE.W   CLK2,[A3]+
001660 36F9 0000               MOVE.W   CLK3,[A3]+
001666 36FC EB90               MOVE.W   #BARKER,[A3]+
00166A 36FC EB90               MOVE.W   #BARKER,[A3]+
00166E 36BC EB90               MOVE.W   #BARKER,[A3]
001672 23CB 0000               MOVE.L   A3,CURPNT
001678 23CB 0000               MOVE.L   A3,LSTEVT        SAVE LAST POINTER
00167E 6100 0EB2               BSR      SAVPAR           SAVE ALL PARAMETERS
001682 0839 0001               BTST     #1,TEST          SEE IF IN AN EVENT
00168A 6600 000A               BNE      CONTA            YES,LEAVE BRAM ON
00168E 08F9 0000               BSET     #0,BRAMON        TURN BRAM OFF
001696 4EF9 0000          CONTA JMP     KEYRET

                          ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                          ;  BKEY      -    SERVICES STATUS INPUTS
                          ;         FORMAT FOR INPUT IS AS FOLLOWS:
                          ;
                          ;         <on> <B> <enter> TT.SN.T1.T2 <enter>
                          ;
                          ;         WHERE TT IS THE TEST NUMBER,
                          ;               SN IS THE SITE NUMBER,
                          ;               T1 IS TRIGGER1,
                          ;               T2 IS TRIGGER2.
                          ;         VALID INPUT CONSISTS OF ANY DIGIT IN ANY VARIABLE.
                          ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

00169C 0679 0001          BKEY  ADDI.W  #01H,COUNT        INCREMENT KEYSTROKE COUNTER
0016A4 0C79 00CC                CMPI.W  #0CCH,KEY         CLEAR COMMAND?
0016AC 6700 01D4                BEQ     BCLEAR
0016B0 0C79 0001                CMPI.W  #01H,COUNT        FIRST KEY?
0016B8 6700 01CC                BEQ     ISSTAT            DISPLAY CURRENT ENTRIES
0016BC 0C79 0002                CMPI.W  #02H,COUNT        SECOND KEY?
0016C4 6700 001A                BEQ     BENT              SHOULD BE ENTER NEW DATA
0016C8 0C79 0013                CMPI.W  #13H,COUNT        19TH KEY?
0016D0 6600 0024                BNE     ISDIGB
0016D4 0C79 00EE                CMPI.W  #0EEH,KEY         ENTER?
0016DC 6700 01C2                BEQ     BENTER

0016E0 0C79 00EE          BENT  CMPI.W  #0EEH,KEY
0016E8 6600 FB36                BNE     ERROR             'KEY ENTRY ERROR'
0016EC 6100 0A58                BSR     INITDS
0016F0 4EF9 0000                JMP     KEYRET

                          ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                          ;         ISDIGB   -    CHECKS FORMAT AND RANGE FOR DATA
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                   ;        5, 8 AND B ARE CHECKED TO BE DECIMAL POINTS.
                   ;:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

0016F6 0C79 0005   ISDIGB   CMPI.W   #05H,COUNT         5TH DIGIT IS DECIMAL
0016FE 6700 0914            BEQ      DECPTS
001702 0C79 0008            CMPI.W   #08H,COUNT         8TH DIGIT IS DECIMAL
00170A 6700 0908            BEQ      DECPTS
00170E 0C79 000B            CMPI.W   #0BH,COUNT         11TH DIGIT IS DECIMAL
001716 6700 08FC            BEQ      DECPTS
00171A 0C79 000E            CMPI.W   #0EH,COUNT         14TH DIGIT IS DECIMAL
001722 6700 08F0            BEQ      DECPTS
001726 0C79 000A            CMPI.W   #0AH,KEY           OTHER KEYS ACCEPT ANY DIGIT
00172E 6C00 FAF0            BGE      ERROR

                   ;:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   ;    SAVEB  -  STORES INPUT DIGITS FOR FURTHER USE.
                   ;:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

001732 0C79 0003   SAVEB    CMPI.W   #03H,COUNT         3RD KEY?
00173A 6600 0012            BNE      B4
00173E 33F9 0000            MOVE.W   KEY,HITT           FIRST DIGIT OF TEST NUMBER
001748 4EF9 0000            JMP      PUTKEY             DISPLAY

00174E 0C79 0004   B4       CMPI.W   #04H,COUNT         4TH KEY
001756 6600 0012            BNE      B6
00175A 33F9 0000            MOVE.W   KEY,LOTT           SECOND DIGIT OF TEST NUMBER
001764 4EF9 0000            JMP      PUTKEY             DISPLAY

00176A 0C79 0006   B6       CMPI.W   #06,COUNT          6TH KEY
001772 6600 0012            BNE      B7
001776 33F9 0000            MOVE.W   KEY,HISN           FIRST DIGIT OF SITE NUMBER
001780 4EF9 0000            JMP      PUTKEY             DISPLAY

001786 0C79 0007   B7       CMPI.W   #07,COUNT          7TH KEY
00178E 6600 0012            BNE      B9
001792 33F9 0000            MOVE.W   KEY,LOSN           SECOND DIGIT OF SITE NUMBER
00179C 4EF9 0000            JMP      PUTKEY

0017A2 0C79 0009   B9       CMPI.W   #09,COUNT          9TH KEY
0017AA 6600 0012            BNE      BA
0017AE 33F9 0000            MOVE.W   KEY,HIT1           FIRST DIGIT OF TIMER1
0017B8 4EF9 0000            JMP      PUTKEY

0017BE 0C79 000A   BA       CMPI.W   #0AH,COUNT         11TH KEY
0017C6 6600 0012            BNE      BC
0017CA 33F9 0000            MOVE.W   KEY,LOT1           SECOND DIGIT OF TIMER1
0017D4 4EF9 0000            JMP      PUTKEY

0017DA 0C79 000C   BC       CMPI.W   #0CH,COUNT         12TH KEY
0017E2 6600 0012            BNE      BD
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0017E6 33F9 0000   1803         MOVE.W  KEY,HIT2          FIRST DIGIT OF TIMER2
0017F0 4EF9 0000   1804         JMP     PUTKEY
                   1805
0017F6 0C79 000D   1806 BD      CMPI.W  #0DH,COUNT        SECOND DIGIT OF TIMER2
0017FE 6600 0012   1807         BNE     BS1
001802 33F9 0000   1808         MOVE.W  KEY,LOT2
00180C 4EF9 0000   1809         JMP     PUTKEY
001812 0C79 000F   1810 BS1     CMPI.W  #0FH,COUNT        DIG. 1 OF S.N.
00181A 6600 001E   1811         BNE     BS2
00181E 0C79 0004   1812         CMPI.W  #04H,KEY          DIG. 1 < 4 ?
001826 6C00 F9F8   1813         BGE     ERROR             MAX S.N. IS 3999
00182A 33F9 0000   1814         MOVE.W  KEY,SN1
001834 4EF9 0000   1815         JMP     PUTKEY
00183A 0C79 0010   1816 BS2     CMPI.W  #10H,COUNT        DIG. 2 OF S.N.
001842 6600 0012   1817         BNE     BS3
001846 33F9 0000   1818         MOVE.W  KEY,SN2
001850 4EF9 0000   1819         JMP     PUTKEY
001856 0C79 0011   1820 BS3     CMPI.W  #11H,COUNT        DIG. 3 OF S.N.
00185E 6600 0012   1821         BNE     BS4
001862 33F9 0000   1822         MOVE.W  KEY,SN3
00186C 4EF9 0000   1823         JMP     PUTKEY
001872 33F9 0000   1824 BS4     MOVE.W  KEY,SN4           DIG. 4 OF S.N.
00187C 4EF9 0000   1825         JMP     PUTKEY
                   1826
                   1827 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1828 ;  BCLEAR   -    CLEARS CURRENT DISPLAY
                   1829 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1830
001882 6100 08C2   1831 BCLEAR   BSR       INITDS
                   1832
                   1833 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1834 ;        ISSTAT   -     RETRIEVES CURRENT STAT VALUE. FOR DISPLAY
                   1835 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1836
001886 4E71        1837 ISSTAT  NOP
001888 41F9 0000   1838         LEA.L   BKDATA,A0
00188E 6100 F7E8   1839         BSR     DSPMSG
001892 13FC 0000   1840         MOVE.B  #00H,DSPADR        RESET DISPLAY ADDR
00189A 4EF9 0000   1841         JMP     KEYRET
                   1842
                   1843 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1844 ;  BENTER -    STORES INPUT DATA IN SPECIFIED BUFFERS
                   1845 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   1846
0018A0 4E71        1847 BENTER  NOP
0018A2 243C        1848         MOVE.L   #3,D2           CONVERT DATA TO ASCII AND
0018A8 45F9 0000   1849         LEA.L    HITT,A2         STORE IN DISPLAY ARRAY
0018AE 47F9 0000   1850         LEA.L    BKDATA,A3
0018B4 321A        1851 DENLP   MOVE.W   (A2)+,D1
0018B6 0001 0030   1852         OR.B     #30H,D1
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0018BA 16C1          1853        MOVE.B    D1,[A3]+
0018BC 321A          1854        MOVE.W    [A2]+,D1
0018BE 0001 0030     1855        OR.B      #30H,D1
0018C2 16C1          1856        MOVE.B    D1,[A3]+
0018C4 16FC 002E     1857        MOVE.B    #2EH,[A3]+
0018C8 51CA FFEA     1858        DBRA      D2,DEPLP
0018CC 321A          1859        MOVE.W    [A2]+,D1          S.N. 1
0018CE 0001 0030     1860        OR.B      #30H,D1
0018D2 16C1          1861        MOVE.B    D1,[A3]+
0018D4 321A          1862        MOVE.W    [A2]+,D1          S.N. 2
0018D6 0001 0030     1863        OR.B      #30H,D1
0018DA 16C1          1864        MOVE.B    D1,[A3]+
0018DC 321A          1865        MOVE.W    [A2]+,D1          S.N. 3
0018DE 0001 0030     1866        OR.B      #30H,D1
0018E2 16C1          1867        MOVE.B    D1,[A3]+
0018E4 321A          1868        MOVE.W    [A2]+,D1          S.N. 4
0018E6 0001 0030     1869        OR.B      #30H,D1
0018EA 16C1          1870        MOVE.B    D1,[A3]+
0018EC 45F9 0000     1871        LEA.L     HITT,A2           ADDR OF DATA
0018F2 47F9 000C     1872        LEA.L     TESTNM,A3         ADDR OF ANSWER
0018F8 223C          1873        MOVE.L    #0,D1             # OF DIGITS/ANSWER
0018FE 243C          1874        MOVE.L    #3,D2             # OF ANSWERS
001904 6100 0732     1875        BSR       MULTIPL           MULTIPLY DATA TO GET ANSWERS
001908 45F9 0000     1876        LEA.L      SN1,A2
00190E 47F9 0000     1877        LEA.L      SERNO,A3
001914 223C          1878        MOVE.L     #2,D1
00191A 243C          1879        MOVE.L     #0,D2
001920 6100 0716     1880        BSR        MULTIPL
001924 47F9 0000     1881        LEA.L      TSTINF,A3      MOVE DATA MESSAGE INTO BRAM
00192A 3779 0000     1882        MOVE.W     TESTNM,TNUM[A3]
001932 3779 0000     1883        MOVE.W     SITENM,SITE[A3]
00193A 3779 0000     1884        MOVE.W     SERNO,SERIAL[A3]
001942 4281          1885        CLR.L      D1
001944 3239 0000     1886        MOVE.W     TIMER1,D1
00194A C2FC 01F4     1887        MULU       #500,D1
00194E 3741 0008     1888        MOVE.W     D1,TMVAL1[A3]
001954 33C1 0000     1889        MOVE.W     D1,TIMR1
001958 4281          1890        CLR.L      D1
00195A 3239 0000     1891        MOVE.W     TIMER2,D1
001960 C2FC 01F4     1892        MULU       #500,D1
001964 3741 000C     1893        MOVE.W     D1,TMVAL2[A3]
001968 33C1 0000     1894        MOVE.W     D1,TIMR2
00196E 08B9 0000     1895        BCLR       #0,BRAMON        TURN ON BAT. RAM
001976 243C          1896        MOVE.L     #50,D2           SET UP FOR 50 USEC. DELAY
00197C 6100 F73A     1897        BSR        DELAY            DELAY
001980 6100 F4F2     1898        BSR        RDCLK
001984 223C          1899        MOVE.L     #1000H,D1
00198A 45F9 0000     1900        LEA.L      TSTINF,A2
001990 2679 0000     1901        MOVE.L     CURFNT,A3
001996 D7FC          1902        ADD.L      #2,A3
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```
00199C 826A 0000                 OR.W      TNUM[A2],D1
0019A0 36C1                      MOVE.W    D1,[A3]+
0019A2 0241 F000                 AND.W     #0F000H,D1
0019A6 0641 1000                 ADD.W     #1000H,D1
0019AA 826A 0002                 OR.W      SITE[A2],D1
0019AE 36C1                      MOVE.W    D1,[A3]+
0019B0 0241 F000                 AND.W     #0F000H,D1
0019B4 0641 1000                 ADD.W     #1000H,D1
0019B8 826A 0004                 OR.W      SERIAL[A2],D1
0019BC 36C1                      MOVE.W    D1,[A3]+
0019BE 0241 F000                 AND.W     #0F000H,D1
0019C2 0641 1000                 ADD.W     #1000H,D1
0019C6 36C1                      MOVE.W    D1,[A3]+
0019C8 36EA 0008                 MOVE.W    TMVAL1[A2],[A3]+
0019CC 0641 1000                 ADD.W     #1000H,D1
0019D0 36C1                      MOVE.W    D1,[A3]+
0019D2 36EA 000C                 MOVE.W    TMVAL2[A2],[A3]+
0019D6 36F9 0000                 MOVE.W    CLK1,[A3]+
0019DC 36F9 0000                 MOVE.W    CLK2,[A3]+
0019E2 36F9 0000                 MOVE.W    CLK3,[A3]+
0019E8 36FC EB90                 MOVE.W    #BARKER,[A3]+
0019EC 36FC EB90                 MOVE.W    #BARKER,[A3]+
0019F0 36BC EB90                 MOVE.W    #BARKER,[A3]
0019F4 23CB 0000                 MOVE.L    A3,CURPNT
0019FA 33FC 0000                 MOVE.W   #00H,FUNCT          NO ACTIVE FUNCTION
001A02 33FC 0000                 MOVE.W   #00H,COUNT          KEY COUNT CLEARED
001A0A 13FC 0000                 MOVE.B   #00H.DSPADR         RESET DISPLAY ADDR
001A12 33FC 0000                 MOVE.W   #00H,ALPHA          CLEAR ALPHA FLAG
001A1A 33FC 0000                 MOVE.W   #00H,POINT          CLEAR DECIMAL POINT
001A22 23CB 0000                 MOVE.L   A3.LSTEVT
001A28 6100 0B08                 BSR      SAVPAR
001A2C 0839 0001                 BTST     #1,TEST             SEE IF IN AN EVENT
001A34 6600 000A                 BNE      CONTB               YES, LEAVE BRAM ON
001A38 08F9 0000                 BSET     #0,BRAMON           ELSE,TURN BRAM OFF
001A40 4EF9 0000       CONTB     JMP      KEYRET

                       ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                       ;  CKEY   -    CALIBRATION ROUTINE UNDEFINED
                       ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

001A46 0679 0001       CKEY       ADDI.W   #1,COUNT
001A4E 0C79 0001                  CMPI.W   #1,COUNT           CHECK FOR FUNC CODE
001A56 6700 0064                  BEQ      CALRET
001A5A 0C79 0001                  CMPI.W   #1,KEY             IS IT CAL 1
001A62 6700 001A                  BEQ      CALMD1
001A66 0C79 0002                  CMPI.W   #2,KEY             IS IT CAL 2
001A6E 6700 002E                  BEQ      CALMD2
001A72 33FC 0003                  MOVE.W   #3,ERRNUM
001A7A 6000 F7A4                  BRA      ERROR
001A7E 08F9 0000       CALMD1     BSET     #00,CALFLG         SET CALIBRATION FLAG
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001A86 23FC                  MOVE.L  #0,CALSUM        RESET SUM  VALUE
001A90 33FC 0FA0             MOVE.W  #4000,CALTIM       RESET CAL PERIOD
001A98 4EF9 0000             JMP     KEYRET           RETURN
001A9E 08F9 0000    CALMD2   BSET    #0,ADSPFLG       SET CAL 2 FLG
001AA6 08F9 0000             BSET    #0,CALFLG
001AAE 33FC 0FA0             MOVE.W  #4000,CALTIM
001AB6 4EF9 0000             JMP     KEYRET
001ABC 41F9 0000    CALRET   LEA.L   CALPRMT,A0
001AC2 6100 F5B4             BSR     DSPMSG           DISPLAY CAL PROMPT
001AC6 4EF9 0000             JMP     KEYRET

                    ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                    ;  DKEY   -     SERVICES SOFT VALUES
                    ;         INPUT IS OF THE FOLLOWING FORMAT:
                    ;
                    ;         (on) (D) (enter) TR3.TR2.PP.RV.RT (enter)
                    ;
                    ;         WHERE TR3 IS TRIGGER3,
                    ;               TR2 IS TRIGGER2,
                    ;               PP IS POSITIVE PULSE TIME
                    ;               RV IS RISETIME IN dBs,
                    ;               RT IS RISETIME IN
                    ::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

001ACC 0679 0001    DKEY     ADD.W   #01H,COUNT       INCREMENT KEYSTROKE COUNT
001AD4 0C79 00CC             CMPI.W  #0CCH,KEY        CLEAR?
001ADC 6700 00C4             BEQ     DCLEAR

001AE0 0C79 0001             CMPI.W  #01H,COUNT       FIRST KEY?
001AE8 6700 00BC             BEQ     ISVAL

001AEC 0C79 0002             CMPI.W  #02H,COUNT       SECOND KEY?
001AF4 6700 0096             BEQ     DENT             SHOULD BE ENTER NEW DATA

001AF8 0C79 0003             CMPI.W  #03H,COUNT       TRIGGER3
001B00 6600 001A             BNE     CHK7
001B04 0C79 0002             CMPI.W  #02H,KEY         KEY SHOULD BE 0 OR 1
001B0C 6D00 032C             BLT     SAVED
001B10 33FC 0003             MOVE.W  #03,ERRNUM       'INVALID NUMBER'
001B18 4EF8 1220             JMP     ERROR

001B1C 0C79 0007    CHK7     CMPI.W  #07H,COUNT       TRIGGER2
001B24 6600 001A             BNE     CHK6
001B28 0C79 0002             CMPI.W  #02H,KEY         KEY SHOULD BE 0 OR 1
001B30 6D00 0308             BLT     SAVED
001B34 33FC 0003             MOVE.W  #03,ERRNUM       'INVALID NUMBER'
001B3C 4EF8 1220             JMP     ERROR

001B40 0C79 0006    CHK6     CMPI.W  #06H,COUNT       FIELDS 6,A,D,10 SHOULD HAVE
001B48 6700 04CA             BEQ     DECPTS           A DECIMAL AS THEIR VALUE
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001B4C 0C79 000A                CMPI.W   #0AH,COUNT
001B54 6700 04BE                BEQ      DECPTS

001B58 0C79 000D                CMPI.W   #0DH,COUNT
001B60 6700 04B2                BEQ      DECPTS

001B64 0C79 0010                CMPI.W   #010H,COUNT
001B6C 6700 04A6                BEQ      DECPTS

001B70 0C79 0013                CMPI.W   #13H,COUNT        19TH KEY MUST BE 'ENTER'
001B78 6700 0046                BEQ      DENTER

001B7C 0C79 000A                CMPI.W   #0AH,KEY          OTHER KEYS MAY BE ANY DIGIT
001B84 6D00 02B4                BLT      SAVED
001B88 6C00 F696                BGE      ERROR             'KEY ENTRY ERROR'

001B8C 0C79 00EE        DENT    CMPI.W   #0EEH,KEY
001B94 6600 F68A                BNE      ERROR             'KEY ENTRY ERROR'
001B98 6100 05AC                BSR      INITDS
001B9C 4EF9 0000                JMP      KEYRET

                        ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                        ;       DCLEAR   -    CLEARS DISPLAY
                        ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

001BA2 6100 05A2        DCLEAR  BSR       INITDS

                        ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                        ;       ISVAL    -    DISPLAYS CURRENT SOFT VALUES
                        ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

001BA6 4E71             ISVAL   NOP
001BA8 41F9 0000                LEA.L    DKDATA,A0
001BAE 6100 F4C8                BSR      DSPMSG
001BB2 13FC 0000                MOVE.B   #00H,DSPADR       RESET DISPLAY ADDR
001BBA 4EF9 0000                JMP      KEYRET

                        ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                        ;       DENTER   -    CHANGES SOFT VALUES ACCORDING TO INPUT
                        ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

001BC0 0C79 00EE        DENTER  CMPI.W   #0EEH,KEY         'ENTER'?
001BC8 6600 F656                BNE      ERROR
001BCC 45F9 0000                LEA.L    HITR3,A2          UPDATE DISPLAY ARRAY WITH
001BD2 47F9 0000                LEA.L    DKDATA,A3         THE NEW D FUNCTION DATA
001BD8 321A                     MOVE.W   (A2)+,D1
001BDA 0001 0030                OR.B     #30H,D1
001BDE 16C1                     MOVE.B   D1,(A3)+
001BE0 321A                     MOVE.W   (A2)+,D1
```

```
001BE2 0001 0030    2053         OR.B     #30H,D1
001BE6 16C1         2054         MOVE.B   D1,(A3)+
001BE8 321A         2055         MOVE.W   (A2)+,D1
001BEA 0001 0030    2056         OR.B     #30H,D1
001BEE 16C1         2057         MOVE.B   D1,(A3)+
001BF0 16FC 002E    2058         MOVE.B   #2EH,(A3)+
001BF4 321A         2059         MOVE.W   (A2)+,D1
001BF6 0001 0030    2060         OR.B     #30H,D1
001BFA 16C1         2061         MOVE.B   D1,(A3)+
001BFC 321A         2062         MOVE.W   (A2)+,D1
001BFE 0001 0030    2063         OR.B     #30H,D1
001C02 16C1         2064         MOVE.B   D1,(A3)+
001C04 321A         2065         MOVE.W   (A2)+,D1
001C06 0001 0030    2066         OR.B     #30H,D1
001C0A 16C1         2067         MOVE.B   D1,(A3)+
001C0C 16FC 002E    2068         MOVE.B   #2EH,(A3)+
001C10 321A         2069         MOVE.W   (A2)+,D1
001C12 0001 0030    2070         OR.B     #30H,D1
001C16 16C1         2071         MOVE.B   D1,(A3)+
001C18 321A         2072         MOVE.W   (A2)+,D1
001C1A 0001 0030    2073         OR.B     #30H,D1
001C1E 16C1         2074         MOVE.B   D1,(A3)+
001C20 16FC 002E    2075         MOVE.B   #2EH,(A3)+
001C24 321A         2076         MOVE.W   (A2)+,D1
001C26 0001 0030    2077         OR.B     #30H,D1
001C2A 16C1         2078         MOVE.B   D1,(A3)+
001C2C 321A         2079         MOVE.W   (A2)+,D1
001C2E 0001 0030    2080         OR.B     #30H,D1
001C32 16C1         2081         MOVE.B   D1,(A3)+
001C34 16FC 002E    2082         MOVE.B   #2EH,(A3)+
001C38 321A         2083         MOVE.W   (A2)+,D1
001C3A 0001 0030    2084         OR.B     #30H,D1
001C3E 16C1         2085         MOVE.B   D1,(A3)+
001C40 321A         2086         MOVE.W   (A2)+,D1
001C42 0001 0030    2087         OR.B     #30H,D1
001C46 1681         2088         MOVE.B   D1,(A3)
001C48 45F9 0000    2089         LEA.L    HITR3,A2          ADDRESS OF DATA
001C4E 47F9 0000    2090         LEA.L    TRIG3,A3          ADDRESS OF ANSWER
001C54 223C         2091         MOVE.L   #1,D1             # OF DIGITS/ANSWER
001C5A 243C         2092         MOVE.L   #1,D2             # OF ANSWERS
001C60 6100 03D6    2093         BSR      MULTIPL
001C64 45F9 0000    2094         LEA.L    HIJV,A2
001C6A 47F9 0000    2095         LEA.L    JMPVAL,A3
001C70 223C         2096         MOVE.L   #0,D1
001C76 243C         2097         MOVE.L   #2,D2
001C7C 6100 03BA    2098         BSR      MULTIPL
001C80 4281         2099         CLR.L    D1
001C82 3239 0000    2100         MOVE.W   TRIG3,D1
001C88 C2FC 0064    2101         MULU     #100,D1
001C8C 45F9 0000    2102         LEA.L    DBTAB,A2
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001C92 203C        2103          MOVE.L    #DBLEN,D0
001C98 0480        2104          SUB.L     #DBHEX,D0
001C9E B272 0000   2105 DENLP1   CMP.W     0(A2,D0),D1
001CA2 6C00 000C   2106          BGE       TR3FND
001CA6 0480        2107          SUB.L     #1,D0
001CAC 51C8 FFF0   2108          DBRA      D0,DENLP1
001CB0 47F9 0000   2109 TR3FND   LEA.L     DBHEX,A3
001CB6 33F3 0000   2110          MOVE.W    0(A3,D0),TRIGR3
001CBE 0079 8000   2111          OR.W      #8000H,TRIGR3
001CC6 3239 0000   2112          MOVE.W    TRIG2,D1
001CCC C2FC 0064   2113          MULU      #100,D1
001CD0 203C        2114          MOVE.L    #DBLEN,D0
001CD6 0480        2115          SUB.L     #DBHEX,D0
001CDC B272 0000   2116 DENLP2   CMP.W     0(A2,D0),D1
001CE0 6C00 000C   2117          BGE       TR2FND
001CE4 0480        2118          SUB.L     #1,D0
001CEA 51C8 FFF0   2119          DBRA      D0,DENLP2
001CEE 33F3 0000   2120 TR2FND   MOVE.W    0(A3,D0),TRIGR2
001CF6 0079 8000   2121          OR.W      #8000H,TRIGR2
001CFE 33F9 0000   2122          MOVE.W    JMPVAL,TRIGR1
001D08 45F9 0000   2123          LEA.L     TSTINF,A2
001D0E 3579 0000   2124          MOVE.W    TRIGR1,TRG1(A2)
001D16 3579 0000   2125          MOVE.W    TRIGR2,TRG2(A2)
001D1E 3779 0000   2126          MOVE.W    TRIGR3,TRG3(A3)
001D26 3579 0000   2127          MOVE.W    RISEDB,PSLOP(A2)
001D2E 3579 0000   2128          MOVE.W    RISETM,PSLTM(A2)
001D36 08B9 0000   2129          BCLR      #0,BRAMON               TURN BAT. RAM ON
001D3E 243C        2130          MOVE.L    #50,D2                  SET FOR 50 USEC. DELAY
001D44 6100 F372   2131          BSR       DELAY                   DELAY
001D48 6100 F12A   2132          BSR       RDCLK
001D4C 2679 0000   2133          MOVE.L    CURPNT,A3
001D52 D7FC        2134          ADD.L     #2,A3
001D58 203C        2135          MOVE.L    #6000H,D0
001D5E 2200        2136          MOVE.L    D0,D1
001D60 8279 0000   2137          OR.W      TRIGR1,D1
001D66 36C1        2138          MOVE.W    D1,(A3)+
001D68 0680        2139          ADD.L     #1000H,D0
001D6E 36C0        2140          MOVE.W    D0,(A3)+
001D70 36F9 0000   2141          MOVE.W    TRIGR2,(A3)+
001D76 0680        2142          ADD.L     #1000H,D0
001D7C 36C0        2143          MOVE.W    D0,(A3)+
001D7E 36F9 0000   2144          MOVE.W    TRIGR3,(A3)+
001D84 0680        2145          ADD.L     #1000H,D0
001D8A 3200        2146          MOVE.W    D0,D1
001D8C 826A 0018   2147          OR.W      PSLOP(A2),D1
001D90 36C1        2148          MOVE.W    D1,(A3)+
001D92 0680        2149          ADD.L     #1000H,D0
001D98 3200        2150          MOVE.W    D0,D1
001D9A 826A 001A   2151          OR.W      PSLTM(A2),D1
001D9E 36C1        2152          MOVE.W    D1,(A3)+
001DA0 36F9 0000               MOVE.W   CLK1,[A3]+
001DA6 36F9 0000               MOVE.W   CLK2,[A3]+
001DAC 36F9 0000               MOVE.W   CLK3,[A3]+
001DB2 36FC EB90               MOVE.W   #BARKER,[A3]+
001DB6 36FC EB90               MOVE.W   #BARKER,[A3]+
001DBA 36BC EB90               MOVE.W   #BARKER,[A3]
001DBE 2039 0000               MOVE.L   TRIGR2H,D0
001DC4 23C0 0000               MOVE.L   D0,TR2HIGH
001DCA 0480                    SUB.L    #8000H,D0
001DD0 23FC                    MOVE.L   #8000H,TR2LOW
001DDA 91B9 0000               SUB.L    D0,TR2LOW
001DE0 23CB 0000               MOVE.L   A3,CURPNT
001DE6 4280                    CLR.L    D0
001DE8 3039 0000               MOVE.W   CURAVG,D0
001DEE 33FC 0000               MOVE.W   #00H,FUNCT          NO FUNCTION ACTIVE
001DF6 33FC 0000               MOVE.W   #00H,COUNT          KEY COUNT CLEARED
001DFE 13FC 0000               MOVE.B   #00H,DSPADR         RESET DISPLAY ADDR
001E06 33FC 0000               MOVE.W   #00H,ALPHA          CLEAR ALPHA FLAG
001E0E 33FC 0000               MOVE.W   #00H,POINT          CLEAR DECIMAL POINT
001E16 23CB 0000               MOVE.L   A3,LSTEVT
001E1C 6100 0714               BSR      SAVPAR
001E20 0839 0001               BTST     #1,TEST             SEE IF IN AN EVENT
001E28 6600 000A               BNE      CONTD               YES,LEAVE BRAM ON
001E2C 08F9 0000               BSET     #0,BRAMON           TURN BRAM OFF
001E34 4EF9 0000        CONTD  JMP      KEYRET

                        ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                        ;      SAVED    -   STORES DIGITS TEMPORARILY FOR LATER USE
                        ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

001E3A 0C79 0003        SAVED  CMPI.W   #03H,COUNT          THIRD KEY?
001E42 6600 0012               BNE      D04
001E46 33F9 0000               MOVE.W   KEY,HITR3           FIRST DIGIT OF TRIGGER 3
001E50 4EF9 0000               JMP      PUTKEY              DISPLAY

001E56 0C79 0004        D04    CMPI.W   #04H,COUNT          FOURTH KEY
001E5E 6600 0012               BNE      D05
001E62 33F9 0000               MOVE.W   KEY,MITR3           SECOND DIGIT OF TRIGGER 3
001E6C 4EF9 0000               JMP      PUTKEY              DISPLAY

001E72 0C79 0005        D05    CMPI.W   #05H,COUNT          FIFTH KEY
001E7A 6600 0012               BNE      D07
001E7E 33F9 0000               MOVE.W   KEY,LOTR3           THIRD DIGIT OF TRIGGER3
001E88 4EF9 0000               JMP      PUTKEY              DISPLAY

001E8E 0C79 0007        D07    CMPI.W   #07H,COUNT          SEVENTH KEY
001E96 6600 0012               BNE      D08
001E9A 33F9 0000               MOVE.W   KEY,HITR2           FIRST DIGIT OF TRIGGER2
001EA4 4EF9 0000               JMP      PUTKEY              DISPLQY

001EAA 0C79 0008        D08    CMPI.W   #08H,COUNT          EIGHTH KEY
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001EB2 6600 0012   2204          BNE       D09
001EB6 33F9 0000   2205          MOVE.W    KEY,MITR2          SECOND DIGIT OF TRIGGER2
001EC0 4EF9 0000   2206          JMP       PUTKEY
                   2207
001EC6 0C79 0009   2208 D09      CMPI.W    #09H,COUNT        9TH KEY
001ECE 6600 0012   2209          BNE       DB
001ED2 33F9 0000   2210          MOVE.W    KEY,LOTR2          THIRD DIGIT OF TRIGGER2
001EDC 4EF9 0000   2211          JMP       PUTKEY             DISPLAY
                   2212
001EE2 0C79 000B   2213 DB       CMPI.W    #0BH,COUNT        11TH KEY
001EEA 6600 0012   2214          BNE       DC
001EEE 33F9 0000   2215          MOVE.W    KEY,HIJV           FIRST DIGIT OF PEAK PERIOD
001EF8 4EF9 0000   2216          JMP       PUTKEY             DISPLAY
                   2217
001EFE 0C79 000C   2218 DC       CMPI.W    #0CH,COUNT        12TH KEY
001F06 6600 0012   2219          BNE       DE
001F0A 33F9 0000   2220          MOVE.W    KEY,LOJV           SECOND DIGIT OF PEAK PERIOD
001F14 4EF9 0000   2221          JMP       PUTKEY             DISPLAY
                   2222
001F1A 0C79 000E   2223 DE       CMPI.W    #0EH,COUNT        14TH KEY
001F22 6600 0012   2224          BNE       DF
001F26 33F9 0000   2225          MOVE.W    KEY,HIRV           FIRST DIGIT OF RISETIME dB
001F30 4EF9 0000   2226          JMP       PUTKEY             DISPLAY
                   2227
001F36 0C79 000F   2228 DF       CMPI.W    #0FH,COUNT        15TH KEY
001F3E 6600 0012   2229          BNE       D11
001F42 33F9 0000   2230          MOVE.W    KEY,LORV           SECOND DIGIT OF RISETIME dB
001F4C 4EF9 0000   2231          JMP       PUTKEY             DISPLAY
                   2232
001F52 0C79 0011   2233 D11      CMPI.W    #11H,COUNT        17TH KEY
001F5A 6600 0012   2234          BNE       D12
001F5E 33F9 0000   2235          MOVE.W    KEY,HIRT           FIRST DIGIT OF RISETIME mSEC
001F68 4EF9 0000   2236          JMP       PUTKEY             DISPLAY
                   2237
001F6E 33F9 0000   2238 D12      MOVE.W    KEY,LORT           SECOND DIGIT OF RISETIME mSEC
001F78 4EF9 0000   2239          JMP       PUTKEY             DISPLAY
                   2240
                   2241
                   2242 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   2243 ;
                   2244 ;   E FUNCTION KEY PROCESSOR
                   2245 ;      DISPLAY REMAINING MEMORY
                   2246 ;
                   2247 ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                   2248
001F7E 203C        2249 EKEY     MOVE.L    #ENDBRM,D0          GET END OF MEMORY
001F84 90B9 0000   2250          SUB.L     CURPNT,D0           SUB CURRENT DATA PNTR
001F8A 4281        2251          CLR.L     D1                  CONVERT DIFFERENCE TO
001F8C 80FC 03E8   2252          DIVU      #1000,D0            DECIMAL/ASCII AND
001F90 41F9 0000   2253          LEA.L     MEMMSG,A0           STORE INTO DISPLAY MSG
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```
001F96 10FC 0020                 MOVE.B   #20H,[A0]+
001F9A 0C40 0064       EKEY1     CMP.W    #100,D0
001F9E 6D00 000C                 BLT      EKEY1A
001FA2 0641 0001                 ADD.W    #1,D1
001FA6 0440 0064                 SUB.W    #100,D0
001FAA 60EE                      BRA      EKEY1
001FAC 10BC 0020       EKEY1A    MOVE.B   #20H,[A0]
001FB0 0C41 0000                 CMP.W    #0,D1
001FB4 6700 0008                 BEQ      EKEY1B
001FB8 0001 0030                 OR.B     #30H,D1
001FBC 1081                      MOVE.B   D1,[A0]
001FBE 4241            EKEY1B    CLR.W    D1
001FC0 D1FC                      ADDA.L   #1,A0
001FC6 0C40 000A       EKEY2     CMP.W    #10,D0
001FCA 6D00 000C                 BLT      EKEY2A
001FCE 0641 0001                 ADD.W    #1,D1
001FD2 0440 000A                 SUB.W    #10,D0
001FD6 60EE                      BRA      EKEY2
001FD8 0001 0030       EKEY2A    OR.B     #30H,D1
001FDC 10C1                      MOVE.B   D1,[A0]+
001FDE 0000 0030                 OR.B     #30H,D0
001FE2 1080                      MOVE.B   D0,[A0]
001FE4 41F9 0000                 LEA.L    MEMMSG,A0
001FEA 6100 F08C                 BSR      DSPMSG
001FEE 4EF9 0000                 JMP      KEYRET

                       ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                       ;   F FUNCTION KEY PROCESSOR
                       ;     MANUAL SAVE DATA
                       ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

001FF4 33FC 0001       FKEY      MOVE.W    #1,DATSAV
001FFC 41F9 0000                 LEA.L     SAVMSG,A0
002002 6100 F074                 BSR       DSPMSG
002006 33FC 0000                 MOVE.W    #0,OFF
00200E 4EF9 0000                 JMP       KEYRET

                       ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                       ;   DECPTS  -  HANDLE DECIMAL POINTS FOR EACH FUNCTION.
                       ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

002014 4E71            DECPTS    NOP
002016 0C79 0001                 CMPI.W   #01,POINT          IS DECIMAL POINT TURNED ON?
00201E 6600 F200                 BNE      ERROR              'KEY ENTRY ERROR'
002022 33FC 002E                 MOVE.W   #02EH,KEY
00202A 33FC 0000                 MOVE.W   #00H,POINT         CLEAR DECIMAL POINT
002032 4EF9 0000                 JMP      PUTKEY

                       ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                       ;   MULTIPL -  MULTIPLY DATA SENT AND RETURN VALUES
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                ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

002038 4E71     MULTIPL  NOP
00203A 48E7 E0F0         MOVEM.L  D0-D2/A0-A3,-[A7]
00203E 33C1 0000         MOVE.W   D1,DIGITS
002044 4280              CLR.L    D0
002046 D05A     MULTI    ADD.W    [A2]+,D0
002048 C0FC 000A         MULU.W   #0AH,D0
00204C 51C9 FFF8         DBRA     D1,MULTI
002050 D05A              ADD.W    [A2]+,D0
002052 36C0              MOVE.W   D0,[A3]+
002054 4280              CLR.L    D0
002056 3239 0000         MOVE.W   DIGITS,D1
00205C 51CA FFE8         DBRA     D2,MULTI
002060 4CDF 0F07         MOVEM.L  [A7]+,D0-D2/A0-A3
002064 4E75              RTS

                ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                ;   PUTKEY  -  SEND 1 BYTE OF OUTPUT DATA TO WRDISP
                ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

002066 4E71     PUTKEY   NOP
002068 4287              CLR.L    D7
00206A 3E39 0000         MOVE.W   KEY,D7              MOVE RAW INPUT INTO REGISTER
002070 0C79 002E         CMPI.W   #02EH,KEY           IF A DECIMAL POINT DON'T OR
002078 6700 0006         BEQ      PTFND
00207C 0007 0030         OR.B     #30H,D7             CONVERT TO ASCII
002080 E14F     PTFND    LSL      #8,D7               SHIFT LEFT 8 BITS
002082 1E39 0000         MOVE.B   DSPADR,D7           DISPLAY ADDR IN LOWER BYTE
002088 6100 0010         BSR      WRDISP              WRITE OUT INPUT KEY
00208C 0639 0001         ADD.B    #01,DSPADR          INCREMENT THE DISPLAY
002094 4EF9 0000         JMP      KEYRET              GET NEXT INPUT

                ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                ;    WRDISP  -  OUTPUT DATA TO LCD DISPLAY
                ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::

00209A 48E7 0380 WRDISP  MOVEM.L  D6-D7/A0,-[A7]
00209E 41F9 0002         LEA.L    DISPLY,A0           A0 PTS TO THE LCD DISPLAY
0020A4 1C28 0001 LAB1    MOVE.B   1[A0],D6            GET STATUS
0020A8 6BFA              BMI.S    LAB1                BRANCH IF NOT READY
0020AA 6100 00C4         BSR      DSPDEL
0020AE 0007 0080         OR.B     #80H,D7             TURN BIT 7 ON
0020B2 1147 0001         MOVE.B   D7,1[A0]
0020B6 1C28 0001 LAB2    MOVE.B   1[A0],D6            CHECK STATUS AGAIN
0020BA 6BFA              BMI.S    LAB2                BRANCH IF NOT READY
0020BC 6100 00B2         BSR      DSPDEL
0020C0 E04F              LSR      #8,D7               SHIFT DATA BACK TO LOWER BYTE
0020C2 1147 0003         MOVE.B   D7,3[A0]
0020C6 4CDF 01C0         MOVEM.L  [A7]+,D6-D7/A0  POP REGISTERS
```

```
0020CA 4E75                  RTS

            *********************************************************
            *
0020CC 4E71         KEYRET  NOP
0020CE 4CDF 7FFF            MOVEM.L  [A7]+,D0-D7/A0-A6
0020D2 2679 0000            MOVE.L   CURPNT,A3
0020D8 224B                 MOVE.L   A3,A1
0020DA 244B                 MOVE.L   A3,A2
0020DC 284B                 MOVE.L   A3,A4
0020DE 4E71                 NOP
0020E0 4E73                 RTE

            ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
            ;   GETKEY  -  OBTAINS INPUT DATA
            ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

0020E2 4E71         GETKEY   NOP
0020E4 41F9 0002             LEA.L    PIA,A0
0020EA 4285                  CLR.L    D5
0020EC 45F9 0000             LEA.L    KEYLIST,A2        TRANSLATION TABLE
0020F2 1A28 0001             MOVE.B   ADATA[A0],D5
0020F6 D5C5                  ADDA.L   D5,A2
0020F8 4285                  CLR.L    D5
0020FA 1A12                  MOVE.B   [A2],D5
0020FC 33C5 0000             MOVE.W   D5,KEY
002102 0C79 0013             CMPI.W   #13H,KEY          IS KEY A DECIMAL PT?
00210A 6600 000C             BNE      NOTPT
00210E 33FC 0001             MOVE.W   #01H,POINT
002116 4E75                  RTS
002118 0C79 0010    NOTPT    CMPI.W   #10H,KEY          IS KEY NON-ALPHA-NUMERIC?
002120 6D00 0004             BLT      CONTIN
002124 4E75                  RTS
002126 0C79 000A    CONTIN   CMPI.W   #0AH,KEY          IS KEY ALPHA?
00212E 6C00 000C             BGE      SETALF
002132 33FC 0000             MOVE.W   #00H,ALPHA        KEY IS A DIGIT
00213A 4E75                  RTS
00213C 33FC 0001    SETALF   MOVE.W   #01,ALPHA
002144 4E75                  RTS

            ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
            ;  INITDS  -  INITIALIZES THE LCD DISPLAY
            ;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;

002146 48E7 C0C0    INITDS   MOVEM.L  D0-D1/A0-A1,-[A7]
00214A 41F9 0002             LEA.L    DISPLY,A0
002150 43F9 0000             LEA.L    DSLIST,A1
002156 7204                  MOVEQ    #4,D1
002158 1028 0001    INITDS1  MOVE.B   1[A0],D0
00215C 6BFA                  BMI.S    INITDS1
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00215E 6100 0010                BSR      DSPDEL
002162 1159 0001                MOVE.B   [A1]+,1[A0]
002166 51C9 FFF0                DBRA     D1,INITDS1
00216A 4CDF 0303                MOVEM.L  [A7]+,D0-D1/A0-A1
00216E 4E75                     RTS

                        *
                        *  DISPLAY DELAY ROUTINE

002170 48E7 0200        DSPDEL  MOVEM.L  D6,-[A7]
002174 3C3C 0032                MOVE.W   #50,D6
002178 4E71             DDLOOP  NOP
00217A 51CE FFFC                DBRA     D6,DDLOOP
00217E 4CDF 0040                MOVEM.L  [A7]+,D6
002182 4E75                     RTS

                        *     TIMER IRQ     *

002184 4E71             TIMER   NOP
002186 6100 0004                BSR       TIMSUB
00218A 4E73                     RTE

00218C 48E7 0380        TIMSUB  MOVEM.L   D6-D7/A0,-[A7]
002190 41F9 0003                LEA.L     TIMADDR,A0
002196 1C28 0001                MOVE.B    TSTAT[A0],D6          GET TIMER STATUS
00219A 117C 00E1                MOVE.B    #IRQEN,T1CNTRL[A0]    DISABLE TIMER 2
0021A0 117C 00E1                MOVE.B    #IRQEN,T2CNTRL[A0]
0021A6 0C79 0001                CMPI.W    #1,DATSAV
0021AE 6600 001A                BNE       TIMSCON
0021B2 B7FC                     CMPA.L    #ENDBRM,A3            * ADDED 6/7/88
0021B8 6C00 EB14                BGE       RAMFL                 * ADDED 6/7/88
0021BC 6188                     BSR       INITDS
0021BE 97FC                     SUBA.L    #17000,A3
0021C4 244B                     MOVEA.L   A3,A2
0021C6 6000 0242                BRA       CONFND
0021CA 4287             TIMSCON CLR.L     D7
0021CC 3E14                     MOVE.W    [A4],D7
0021CE BEB9 0000                CMP.L     TRIGR3H,D7       SEE IF PEAK WAS ENOUGH
0021D4 6D00 02C8                BLT       NONEVNT        NO - ERASE EVENT

                        *       CHECK PEAK SLOPE

0021D8 B5C9                     CMPA.L    A1,A2          SEE IF VALID DATA
0021DA 6700 02C2                BEQ       NONEVNT        FLAG1 = FLAG2
0021DE 4287                     CLR.L     D7
0021E0 3E39 0000                MOVE.W    TRIGR1,D7
0021E6 0C47 0000                CMP.W     #0,D7
0021EA 6700 005C                BEQ       NEGCHK1
0021EE E94F                     LSL.W     #4,D7
0021F0 2C0B                     MOVE.L    A3,D6
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0021F2 9C8C        2454           SUB.L    A4,D6
0021F4 BE46        2455           CMP.W    D6,D7
0021F6 6D00 0004   2456           BLT      NEGCHK
0021FA 3E06        2457           MOVE.W   D6,D7
0021FC 3A06        2458 NEGCHK    MOVE.W   D6,D5
0021FE 4286        2459           CLR.L    D6
002200 3C34 7000   2460           MOVE.W   0[A4,D7],D6
002204 BCB9 0000   2461           CMP.L    TRIGR2H,D6
00220A 6D00 0292   2462           BLT      NONEVNT
00220E 0447 0002   2463           SUB.W    #2,D7
002212 66E8        2464           BNE      NEGCHK
002214 4286        2465 NEGPKCHK  CLR.L    D6
002216 2C39 0000   2466           MOVE.L   NEGPK,D6
00221C BCB9 0000   2467           CMP.L    TR2LOW,D6
002222 6E00 027A   2468           BGT      NONEVNT
002226 4286        2469           CLR.L    D6
002228 4285        2470           CLR.L    D5
00222A 3A39 0000   2471           MOVE.W   TRIGR1,D5
002230 E34D        2472           LSL.W    #1,D5
002232 4445        2473           NEG.W    D5
002234 3C35 5000   2474 NEGPLP    MOVE.W   0[A5,D5.W],D6
002238 BCB9 0000   2475           CMP.L    TR2LOW,D6
00223E 6E00 025E   2476           BGT      NONEVNT
002242 0645 0002   2477           ADD.W    #2,D5
002246 66EC        2478           BNE      NEGPLP
002248 4287        2479 NEGCHK1   CLR.L    D7
00224A 4286        2480           CLR.L    D6
00224C 41F9 0000   2481           LEA.L    TSTINF,A0     GET PARAMETER TABLE
002252 3C28 0018   2482           MOVE.W   PSLOP[A0],D6  GET SLOPE PARAMETER
002256 CCFC 0064   2483           MULU     #100,D6
00225A 3E28 001A   2484           MOVE.W   PSLTM[A0],D7  GET SLOPE TIME PARAMETER
00225E E98F        2485           LSL.L    #4,D7         *16 TO CNVRT MSEC. TO SAMPLES
002260 204C        2486           MOVE.L   A4,A0         SAVE PEAK POINTER
002262 91C7        2487           SUB.L    D7,A0         SUBTRACT SLOPE TIME
002264 B1C9        2488           CMP.L    A1,A0         SEE IF POINTER BEFORE BOE
002266 6E00 0010   2489           BGT      CHKCONT
00226A 2049        2490           MOVE.L   A1,A0         SET TO BEGIN OF EVENT
00226C D1FC        2491           ADDA.L   #2,A0         POSITION PNTR TO BOD
002272 B1CC        2492           CMPA.L   A4,A0
002274 6C00 0194   2493           BGE      CONFND
002278 2E3C        2494 CHKCONT   MOVE.L   #DBLEN,D7     GET LENGTH OF DB TABLE
00227E 0487        2495           SUB.L    #DBHEX,D7
002284 3A10        2496           MOVE.W   [A0],D5       GET PEAK-TIME VALUE
002286 0C45 0000   2497           CMPI.W   #0,D5
00228A 6E00 006A   2498           BGT      CHKFPK
00228E 41F9 0000   2499           LEA.L    DBHEX,A0      POINT TO DB HEX TABLE
002294 0442 8000   2500           SUB.W    #8000H,D2
002298 B470 7000   2501 PLOOP     CMP.W    0[A0,D7],D2   SEACH FOR PEAK IN DB
00229C 6C00 0010   2502           BGE      PFIND         PEAK FOUND
0022A0 0487        2503           SUB.L    #1,D7
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0022A6 51CF FFF0            DBRA     D7,PLOOP        ELSE DECR. POINTER
0022AA 6000 004A            BRA      CHKFPK          IF PNTR GOES - NO DB
0022AE 41F9 0000  PFIND     LEA.L    DBTAB,A0        GET DBTABLE
0022B4 3430 7000            MOVE.W   0[A0,D7],D2     GET PEAK VAL IN DB
0022B8 41F9 0000            LEA.L    DBHEX,A0        POINT BACK TO HEX TABLE
0022BE 2E3C                 MOVE.L   #DBLEN,D7
0022C4 0487                 SUB.L    #DBHEX,D7
0022CA 0445 8000            SUB.W    #8000H,D5
0022CE BA70 7000  PSLOOP    CMP.W    0[A0,D7],D5     LOOK FOR DB OF OTHER POINT
0022D2 6C00 0010            BGE      SFIND           MATCH FOUND
0022D6 0487                 SUB.L    #1,D7
0022DC 51CF FFF0            DBRA     D7,PSLOOP       ELSE DECR. POINTER
0022E0 6000 0014            BRA      CHKFPK          IF D7 GOES - NOT IN TABLE
0022E4 41F9 0000  SFIND     LEA.L    DBTAB,A0        POINT TO DBTABLE
0022EA 3A30 7000            MOVE.W   0[A0,D7],D5     GET OTHER DB VALUE
0022EE 9445                 SUB.W    D5,D2           GET DIF. OF PEAK & OTHER VAL.
0022F0 BC42                 CMP.W    D2,D6           IS SLOPE .LE. SLOPE PARAMETER
0022F2 6F00 0116            BLE      CONFND          NO
0022F6 4286       CHKFPK    CLR.L    D6
0022F8 204C                 MOVE.L   A4,A0           SAVE PEAK
0022FA 3C20       PKEND     MOVE.W   -[A0],D6        GET PEAK VALUE
0022FC BCB9 0000            CMP.L    TRIGB3H,D6      PEAK < PEAK THRESHOLD
002302 6D00 0006            BLT      FNDST           YES - GO FIND FIRST PEAK
002306 B1C9                 CMPA.L   A1,A0           AT BEGINNING OF DATA?
002308 6EF0                 BGT      PKEND           NO - CONTINUE
00230A 4285       FNDST     CLR.L    D5
00230C 3A18                 MOVE.W   [A0]+,D5        SAVE FIRST VALUE
00230E 3C18       FNDPK     MOVE.W   [A0]+,D6        GET NEXT VALUE
002310 B1CC                 CMPA.L   A4,A0
002312 6E00 018A            BGT      NONEVNT
002316 BC85                 CMP.L    D5,D6           VALUE < PREVIOUS VALUE?
002318 6D00 0006            BLT      FNDBOT          YES - FIRST PEAK FOUND
00231C 3A06                 MOVE.W   D6,D5           NO - SET PREVIOUS VALUE
00231E 60EE                 BRA      FNDPK
002320 2E08       FNDBOT    MOVE.L   A0,D7
002322 0487                 SUB.L    #4,D7
002328 3406                 MOVE.W   D6,D2
00232A 0442 000A            SUB.W    #10,D2
00232E 3A06                 MOVE.W   D6,D5
002330 3C18       BOTCONT   MOVE.W   [A0]+,D6
002332 BC82                 CMP.L    D2,D6
002334 6F00 0010            BLE      BOTFND
002338 BC85                 CMP.L    D5,D6
00233A 6E00 0010            BGT      NXTPK
00233E B1CC                 CMPA.L   A4,A0
002340 6C00 015C            BGE      NONEVNT
002344 60EA                 BRA      BOTCONT
002346 2047       BOTFND    MOVEA.L  D7,A0
002348 6000 0006            BRA      PKFND
00234C 2A06       NXTPK     MOVE.L   D6,D5
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00234E 60BE         2554          BRA       FNDPK
002350 2408         2555 PKFND    MOVE.L    A0,D2          SAVE FIRST PEAK POINTER
002352 49F9 0000    2556          LEA.L     TSTINF,A4      GET SLOPE TIME PARAMETER
002358 4287         2557          CLR.L     D7
00235A 3E2C 001A    2558          MOVE.W    PSLTM[A4],D7
00235E E98F         2559          LSL.L     #4,D7
002360 8EFC 0003    2560          DIVU      #3,D7          TAKE 1/3 OF TIME
002364 0287         2561          ANDI.L    #0FFFEH,D7
00236A 9487         2562          SUB.L     D7,D2          MOVE POINTER BACK IN TIME
00236C B489         2563          CMP.L     A1,D2          SEE IF BEFORE EVENT
00236E 6E00 000A    2564          BGT       FPCONT
002372 2409         2565          MOVE.L    A1,D2
002374 0682         2566          ADD.L     #2,D2
00237A 4285         2567 FPCONT   CLR.L     D5
00237C 3A10         2568          MOVE.W    [A0],D5        GET FIRST PEAK VALUE
00237E 0445 8000    2569          SUB.W     #8000H,D5
002382 2E3C         2570          MOVE.L    #DBLEN,D7
002388 0487         2571          SUB.L     #DBHEX,D7
00238E 49F9 0000    2572          LEA.L     DBHEX,A4
002394 BA74 7000    2573 FPLOP    CMP.W     0[A4,D7],D5    FIND IN DB TABLE
002398 6C00 0010    2574          BGE       FPFND
00239C 0487         2575          SUB.L     #1,D7
0023A2 51CF FFF0    2576          DBRA      D7,FPLOP
0023A6 6000 00F6    2577          BRA       NONEVNT        IF NOT IN TABLE - NON-EVENT
0023AA 49F9 0000    2578 FPFND    LEA.L     DBTAB,A4
0023B0 3A34 7000    2579          MOVE.W    0[A4,D7],D5    GET VALUE OF DB PEAK
0023B4 49F9 0000    2580          LEA.L     DBHEX,A4
0023BA 2E3C         2581          MOVE.L    #DBLEN,D7
0023C0 0487         2582          SUB.L     #DBHEX,D7
0023C6 2042         2583          MOVEA.L   D2,A0
0023C8 4282         2584          CLR.L     D2
0023CA 3410         2585          MOVE.W    [A0],D2
0023CC 0482         2586          SUB.L     #8000H,D2
0023D2 B474 7000    2587 FPSLOP   CMP.W     0[A4,D7],D2    FIND FIRST POINT IN DB TABLE
0023D6 6C00 0010    2588          BGE       FPSFND
0023DA 0487         2589          SUB.L     #1,D7
0023E0 51CF FFF0    2590          DBRA      D7,FPSLOP
0023E4 6000 00B8    2591          BRA       NONEVNT        IF NOT IN TABLE - NON EVENT
0023E8 49F9 0000    2592 FPSFND   LEA.L     DBTAB,A4       GET DB VALUE OF FIRST POINT
0023EE 3434 7000    2593          MOVE.W    0[A4,D7],D2
0023F2 9A42         2594          SUB.W     D2,D5          CALC DB DIFFERENCE
0023F4 49F9 0000    2595          LEA.L     TSTINF,A4
0023FA 4286         2596          CLR.L     D6
0023FC 3C2C 0018    2597          MOVE.W    PSLOP[A4],D6   GET SLOPE PARAMETER
002400 CCFC 0064    2598          MULU      #100,D6
002404 BC45         2599          CMP.W     D5,D6          IF SLOPE < PARAMETER
002406 6E00 0096    2600          BGT       NONEVNT        NON - EVENT
00240A D5FC         2601 CONFND   ADDA.L    #2,A2          INCR BOOM POINTER
002410 6100 EA62    2602          BSR       RDCLK          GET CURRENT TIME
002414 34F9 0000    2603          MOVE.W    CLK1,[A2]+     STORE CURRENT TIME
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00241A 34F9 0000   2604          MOVE.W    CLK2,[A2]+
002420 34F9 0000   2605          MOVE.W    CLK3,[A2]+
002426 34C3        2606          MOVE.W    D3,[A2]+       STORE AVERAGE
002428 34FC EB90   2607          MOVE.W    #BARKER,[A2]+  MOVE IN BARKER CODES
00242C 34FC EB90   2608          MOVE.W    #BARKER,[A2]+
002430 34BC EB90   2609          MOVE.W    #BARKER,[A2]
002434 0C79 03E7   2610          CMP.W     #999,VBOOM
00243C 6D00 000A   2611          BLT       CONT1
002440 33FC 0000   2612          MOVE.W    #0,VBOOM
002448 0679 0001   2613 CONT1    ADD.W     #1,VBOOM       INCR. VALID BOOM COUNT
002450 3439 0000   2614          MOVE.W    VBOOM,D2
002456 6100 00FA   2615          BSR       HEXCNVT        CONVERT TO DECIMAL ASCII
00245A 41F9 0000   2616          LEA.L     BOOMSG1,A0     STORE IN DISPLAY MSG
002460 10F9 0000   2617          MOVE.B    HUND,[A0]+     STORE 100 DIGIT
002466 10F9 0000   2618          MOVE.B    TEN,[A0]+      STORE 10 DIGIT
00246C 10B9 0000   2619          MOVE.B    UNIT,[A0]      STORE 1 DIGIT
002472 41F9 0000   2620 CONT1A   LEA.L     BOOMSG1,A0
002478 6100 EBFE   2621          BSR       DSPMSG         DISPLAY MESSAGE
00247C B7FC        2622          CMPA.L   #ENDBRM,A3       CHECK FOR END OF RAM
002482 6C00 E84A   2623          BGE       RAMFL          IF YES STOP
002486 224A        2624          MOVEA.L   A2,A1          ELSE RESET FLAGS
002488 264A        2625          MOVEA.L   A2,A3
00248A 284A        2626          MOVEA.L   A2,A4
00248C 2A4A        2627          MOVEA.L   A2,A5
00248E 23CA 0000   2628          MOVE.L    A2,LSTEVT
002494 23CA 0000   2629          MOVE.L    A2,CURPNT
00249A 6000 0062   2630          BRA       TIMEXT         AND EXIT
00249E 2279 0000   2631 NONEVNT  MOVE.L    LSTEVT,A1      RESET FLAGS
0024A4 2449        2632          MOVEA.L   A1,A2
0024A6 2649        2633          MOVEA.L   A1,A3
0024A8 2849        2634          MOVEA.L   A1,A4
0024AA 2A49        2635          MOVEA.L   A1,A5
0024AC B3FC        2636          CMPA.L    #ENDDATA,A1 0024B2 6C00 E81A   2637           BGE       RAMFL
0024B6 0C79 03E7   2638          CMP.W     #999,NVBOOM
0024BE 6D0C 000A   2639          BLT       CONT2
0024C2 33FC 0000   2640          MOVE.W    #0,NVBOOM
0024CA 0679 0001   2641 CONT2    ADD.W     #1,NVBOOM      INCR NON-BOOM COUNT
0024D2 3439 0000   2642          MOVE.W    NVBOOM,D2
0024D8 6100 0078   2643          BSR       HEXCNVT        CONVERT TO DECIMAL ASCII
0024DC 41F9 0000   2644          LEA.L     BOOMSG2,A0
0024E2 10F9 0000   2645          MOVE.B    HUND,[A0]+     STORE COUNT IN MSG
0024E8 10F9 0000   2646          MOVE.B    TEN,[A0]+
0024EE 10B9 0000   2647          MOVE.B    UNIT,[A0]
0024F4 41F9 0000   2648          LEA.L     BOOMSG1,A0
0024FA 6100 EB7C   2649          BSR       DSPMSG         DISPLAY COUNT MESSAGE
0024FE 4282        2650 TIMEXT   CLR.L     D2             ZERO PEAK VALUE
002500 23FC        2651          MOVE.L    #8000,NEGPK
00250A 33C2 0000   2652          MOVE.W    D2,DATSAV
002510 08B9 0001   2653          BCLR      #1,TEST        CLEAR TIMER 1 FLAG
002518 08B9 0002   2654          BCLR      #2,TEST        CLEAR TIMER 2 FLAG
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002520 6100 0010            BSR      SAVPAR
002524 08F9 0000            BSET     #0,BRAMON      TURN OFF BAT. RAM
00252C 4CDF 01C0            MOVEM.L  [A7]+,D6-D7/A0
002530 4E75                 RTS

                     *
                     *
002532 48E7 00C0     SAVPAR MOVEM.L   A0-A1,-[A7]
002536 41F9 0087            LEA.L     VARSTR,A0
00253C 43F9 0000            LEA.L     SRAM,A1
002542 10D9          PARLOP MOVE.B    [A1]+,[A0]+
002544 B3FC                 CMPA.L    #ENDVAR,A1
00254A 6DF6                 BLT       PARLOP
00254C 4CDF 0300            MOVEM.L   [A7]+,A0-A1
002550 4E75                 RTS


                     *  THIS ROUTINE CONVERTS THE VALUE IN D2
                     *  TO DECIMAL ASCII.THE RESULT IS RETURNED IN
                     *  HUND,TEN,UNIT.THE INPUT VALUE MUST BE BETWEEN
                     *  0 AND 999 DECIMAL.
                     *

002552 13FC 0000     HEXCNVT MOVE.B  #0,HUND
00255A 13FC 0000             MOVE.B  #0,TEN
002562 13FC 0000             MOVE.B  #0,UNIT
00256A 0C42 0064     HUNLP   CMP.W   #100,D2
00256E 6D00 0010             BLT     TENLP
002572 0442 0064             SUB.W   #100,D2
002576 0639 0001             ADD.B   #1,HUND
00257E 60EA                  BRA     HUNLP
002580 0C42 000A     TENLP   CMP.W   #10,D2
002584 6D00 0010             BLT     UNITLP
002588 0442 000A             SUB.W   #10,D2
00258C 0639 0001             ADD.B   #1,TEN
002594 60EA                  BRA     TENLP
002596 13C2 0000     UNITLP  MOVE.B  D2,UNIT
00259C 0039 0030             OR.B    #30H,HUND
0025A4 0039 0030             OR.B    #30H,TEN
0025AC 0039 0030             OR.B    #30H,UNIT
0025B4 4E75                  RTS


0025B6 4E73          LITNG   RTE




                     ;::::::::::::::::::::::::::::::::::::::::::::::::::::::::
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                         2705 ;  DB TABLE
                         2706 ;
                         2707 ;:::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::::
                         2708
                         2709 ;                   DB VAL     HEX  DECIMAL
                         2710
0025B8 1B58              2711 DBTAB     DC.W     7000        0   0
0025BA 1E14              2712           DC.W     7700        1   1
0025BC 1FA4              2713           DC.W     8100        2   2
0025BE 20D0              2714           DC.W     8400        3   3
0025C0 21FC              2715           DC.W     8700        4   4
0025C2 22C4              2716           DC.W     8900        5   5
0025C4 2328              2717           DC.W     9000        6   6
0025C6 23F0              2718           DC.W     9200        7   7
0025C8 2454              2719           DC.W     9300        8   8
0025CA 24B8              2720           DC.W     9400        9   9
0025CC 251C              2721           DC.W     9500        A   10
0025CE 2580              2722           DC.W     9600        B   11
0025D0 25E4              2723           DC.W     9700        D   13
0025D2 2648              2724           DC.W     9800        E   14
0025D4 26AC              2725           DC.W     9900        10  16
0025D6 2710              2726           DC.W     10000       12  18
0025D8 2774              2727           DC.W     10100       14  20
0025DA 27D8              2728           DC.W     10200       16  22
0025DC 283C              2729           DC.W     10300       19  25
0025DE 28A0              2730           DC.W     10400       1C  28
0025E0 2904              2731           DC.W     10500       20  32
0025E2 2968              2732           DC.W     10600       23  35
0025E4 29CC              2733           DC.W     10700       28  40
0025E6 2A30              2734           DC.W     10800       2D  45
0025E8 2A94              2735           DC.W     10900       32  50
0025EA 2AF8              2736           DC.W     11000       38  56
0025EC 2B5C              2737           DC.W     11100       3F  63
0025EE 2BC0              2738           DC.W     11200       47  71
0025F0 2C24              2739           DC.W     11300       4F  79
0025F2 2C88              2740           DC.W     11400       59  89
0025F4 2CEC              2741           DC.W     11500       64  100
0025F6 2D50              2742           DC.W     11600       70  112
0025F8 2DB4              2743           DC.W     11700       7E  126
0025FA 2E18              2744           DC.W     11800       8D  141
0025FC 2E7C              2745           DC.W     11900       9E  158
0025FE 2EE0              2746           DC.W     12000       B2  178
002600 2F44              2747           DC.W     12100       C8  200
002602 2F58              2748           DC.W     12120       CC  204
002604 2F6C              2749           DC.W     12140       D1  209
002606 2F80              2750           DC.W     12160       D6  214
002608 2F94              2751           DC.W     12180       DB  219
00260A 2FA8              2752           DC.W     12200       E0  224
00260C 2FBC              2753           DC.W     12220       E5  229
00260E 2FD0              2754           DC.W     12240       EA  234
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002610 2FE4          2755          DC.W      12260      F0   240
002612 2FF8          2756          DC.W      12280      F5   245
002614 300C          2757          DC.W      12300      FB   251
002616 3020          2758          DC.W      12320      101  257
002618 3034          2759          DC.W      12340      107  263
00261A 3048          2760          DC.W      12360      10D  269
00261C 305C          2761          DC.W      12380      113  275
00261E 3070          2762          DC.W      12400      11A  282
002620 3084          2763          DC.W      12420      120  288
002622 3098          2764          DC.W      12440      127  295
002624 30AC          2765          DC.W      12460      12E  302
002626 30C0          2766          DC.W      12480      135  309
002628 30D4          2767          DC.W      12500      13C  316
00262A 30E8          2768          DC.W      12520      144  324
00262C 30FC          2769          DC.W      12540      14B  331
00262E 3110          2770          DC.W      12560      153  339
002630 3124          2771          DC.W      12580      15B  347
002632 3138          2772          DC.W      12600      163  355
002634 314C          2773          DC.W      12620      16B  363
002636 3160          2774          DC.W      12640      174  372
002638 3174          2775          DC.W      12660      17C  380
00263A 3188          2776          DC.W      12680      185  389
00263C 319C          2777          DC.W      12700      18E  398
00263E 31B0          2778          DC.W      12720      197  407
002640 31C4          2779          DC.W      12740      1A1  417
002642 31D8          2780          DC.W      12760      1AB  427
002644 31EC          2781          DC.W      12780      1B5  437
002646 3200          2782          DC.W      12800      1BF  447
002648 3264          2783          DC.W      12900      1F5  501
00264A 32C8          2784          DC.W      13000      232  562
00264C 332C          2785          DC.W      13100      277  631
00264E 3390          2786          DC.W      13200      2C4  708
002650 33F4          2787          DC.W      13300      31A  794
002652 3458          2788          DC.W      13400      37B  891
002654 34BC          2789          DC.W      13500      3E8  1000
002656 3520          2790          DC.W      13600      462  1122
002658 3584          2791          DC.W      13700      4EB  1259
00265A 35E8          2792          DC.W      13800      585  1413
00265C 364C          2793          DC.W      13900      631  1585
00265E 36B0          2794          DC.W      14000      6F2  1778
002660 3714          2795          DC.W      14100      7CB  1995
002662 3778          2796          DC.W      14200      8BF  2239
002664 37DC          2797          DC.W      14300      9D0  2512
002666 3840          2798          DC.W      14400      B02  2818
002668 38A4          2799          DC.W      14500      C5A  3162
00266A 3908          2800          DC.W      14600      DDC  3548
00266C 396C          2801          DC.W      14700      F8D  3981
00266E 39D0          2802          DC.W      14800      1173 4467
002670 3A34          2803          DC.W      14900      1394 5012
002672 3A98          2804          DC.W      15000      15F7 5623
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002674 3AFC          2805             DC.W     15100        18A6 6310
002676 3B60          2806             DC.W     15200        1BA7 7079
002678 3BC4          2807             DC.W     15300        1F07 7943
00267A 3C28          2808             DC.W     15400        22D1 8913
00267C 3C8C          2809             DC.W     15500        2710 10000
00267E 3CF0          2810             DC.W     15600        2BD4 11220
002680 3D54          2811             DC.W     15700        312D 12589
002682 3DB8          2812             DC.W     15800        372D 14125
002684 3E1C          2813             DC.W     15900        3DE9 15849
002686 3E80          2814             DC.W     16000        4577 17783
002688 3EE4          2815             DC.W     16100        4DF1 19953
00268A 3F48          2816             DC.W     16200        5773 22387
00268C 3FAC          2817             DC.W     16300        621F 25119
00268E 4010          2818             DC.W     16400        6E18 28184
002690 4074          2819             DC.W     16500        7B87 31623
002692 40D8          2820             DC.W     16600        7FFF 32767
                     2821
002694 0000          2822 DBHEX       DC.W     0H
002696 0001          2823             DC.W     1H
002698 0002          2824             DC.W     2H
00269A 0003          2825             DC.W     3H
00269C 0004          2826             DC.W     4H
00269E 0005          2827             DC.W     5H
0026A0 0006          2828             DC.W     6H
0026A2 0007          2829             DC.W     7H
0026A4 0008          2830             DC.W     8H
0026A6 0009          2831             DC.W     9H
0026A8 000A          2832             DC.W     0AH
0026AA 000B          2833             DC.W     0BH
0026AC 000D          2834             DC.W     0DH
0026AE 000E          2835             DC.W     0EH
0026B0 0010          2836             DC.W     10H
0026B2 0012          2837             DC.W     12H
0026B4 0014          2838             DC.W     14H
0026B6 0016          2839             DC.W     16H
0026B8 0019          2840             DC.W     19H
0026BA 001C          2841             DC.W     1CH
0026BC 0020          2842             DC.W     20H
0026BE 0023          2843             DC.W     23H
0026C0 0028          2844             DC.W     28H
0026C2 002D          2845             DC.W     2DH
0026C4 0032          2846             DC.W     32H
0026C6 0038          2847             DC.W     38H
0026C8 003F          2848             DC.W     3FH
0026CA 0047          2849             DC.W     47H
0026CC 004F          2850             DC.W     4FH
0026CE 0059          2851             DC.W     59H
0026D0 0064          2852             DC.W     64H
0026D2 0070          2853             DC.W     70H
0026D4 007E          2854             DC.W     7EH
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0026D6 008D          2855          DC.W      8DH
0026D8 009E          2856          DC.W      9EH
0026DA 00B2          2857          DC.W      0B2H
0026DC 00C8          2858          DC.W      0C8H
0026DE 00CC          2859          DC.W      0CCH
0026E0 00D1          2860          DC.W      0D1H
0026E2 00D6          2861          DC.W      0D6H
0026E4 00DB          2862          DC.W      0DBH
0026E6 00E0          2863          DC.W      0E0H
0026E8 00E5          2864          DC.W      0E5H
0026EA 00EA          2865          DC.W      0EAH
0026EC 00F0          2866          DC.W      0F0H
0026EE 00F5          2867          DC.W      0F5H
0026F0 00FB          2868          DC.W      0FBH
0026F2 0101          2869          DC.W      101H
0026F4 0107          2870          DC.W      107H
0026F6 010D          2871          DC.W      10DH
0026F8 0113          2872          DC.W      113H
0026FA 011A          2873          DC.W      11AH
0026FC 0120          2874          DC.W      120H
0026FE 0127          2875          DC.W      127H
002700 012E          2876          DC.W      12EH
002702 0135          2877          DC.W      135H
002704 013C          2878          DC.W      13CH
002706 0144          2879          DC.W      144H
002708 014B          2880          DC.W      14BH
00270A 0153          2881          DC.W      153H
00270C 0153          2882          DC.W      153H
00270E 0163          2883          DC.W      163H
002710 016B          2884          DC.W      16BH
002712 0174          2885          DC.W      174H
002714 017C          2886          DC.W      17CH
002716 0185          2887          DC.W      185H
002718 018E          2888          DC.W      18EH
00271A 0197          2889          DC.W      197H
00271C 01A1          2890          DC.W      1A1H
00271E 01AB          2891          DC.W      1ABH
002720 01B5          2892          DC.W      1B5H
002722 01BF          2893          DC.W      1BFH
002724 01F5          2894          DC.W      1F5H
002726 0232          2895          DC.W      232H
002728 0277          2896          DC.W      277H
00272A 02C4          2897          DC.W      2C4H
00272C 031A          2898          DC.W      31AH
00272E 037B          2899          DC.W      37BH
002730 03E8          2900          DC.W      3E8H
002732 0462          2901          DC.W      462H
002734 04EB          2902          DC.W      4EBH
002736 0585          2903          DC.W      585H
002738 0631          2904          DC.W      631H
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00273A 06F2           2905            DC.W    6F2H
00273C 07CB           2906            DC.W    7CBH
00273E 08BF           2907            DC.W    8BFH
002740 09D0           2908            DC.W    9D0H
002742 0B02           2909            DC.W    0B02H
002744 0C5A           2910            DC.W    0C5AH
002746 0DDC           2911            DC.W    0DDCH
002748 0F8D           2912            DC.W    0F8DH
00274A 1173           2913            DC.W    1173H
00274C 1394           2914            DC.W    1394H
00274E 15F7           2915            DC.W    15F7H
002750 18A6           2916            DC.W    18A6H
002752 1BA7           2917            DC.W    1BA7H
002754 1F07           2918            DC.W    1F07H
002756 22D1           2919            DC.W    22D1H
002758 2710           2920            DC.W    2710H
00275A 2BD4           2921            DC.W    2BD4H
00275C 312D           2922            DC.W    312DH
00275E 372D           2923            DC.W    372DH
002760 3DE9           2924            DC.W    3DE9H
002762 4577           2925            DC.W    4577H
002764 4DF1           2926            DC.W    4DF1H
002766 5773           2927            DC.W    5773H
002768 621F           2928            DC.W    621FH
00276A 6E18           2929            DC.W    6E18H
00276C 7B87           2930            DC.W    7B87H
00276E 7FFF           2931            DC.W    7FFFH
               (276E) 2932 DBLEN      EQU     *-2
                      2933
                      2934
002770 06 34 0E       2935 DSLIST     DC.B    6,34H,0EH,1,3,0
002776 0A 09 08       2936 KEYLIST    DC.B    0AH,09H,08H,07H,0BH,06H,05H,04H
00277E 0C 03 02       2937            DC.B    0CH,03H,02H,01H,0DH,0EH,0FH,00H
002786 FF EE CC       2938            DC.B    0FFH,0EEH,0CCH,013H
00278A 2A 2A 2A       2939 RDYMSG     DC.B    '***  READY  *** '
00279A 20 20 53       2940 SAVMSG     DC.B    '  SAVING DATA   '
0027AA 20 20 20       2941 MEMTEXT    DC.B    '     K BYTES LEFT'
0027BA 20 42 41       2942 FULLMSG    DC.B    ' BAT. RAM FULL  '
0027CA 2A 2A 20       2943 ROMMSG     DC.B    '** ROM ERROR ** '
0027DA 53 54 41       2944 SRAMSG     DC.B    'STATIC RAM ERROR'
0027EA 20 42 41       2945 BRAMSG     DC.B    ' BAT. RAM ERROR '
0027FA 30 30 30       2946 BOMMSG     DC.B    '000-YES / NO-000'
00280A 45 4E 54       2947 CALPRMT    DC.B    'ENTER CAL. CODE '
00281A 4B 45 59       2948 ERRMSG     DC.B    'KEY ENTRY ERROR '
00282A 4E 4F 54       2949            DC.B    'NOT ACTIVE      '
00283A 53 45 4C       2950            DC.B    'SELECT FUNCTION '
00284A 49 4E 56       2951            DC.B    'INVALID NUMBER  '
00285A 38 38 30       2952 AKINIT     DC.B    38H,38H,30H,35H,32H,30H,2EH,30H
002862 30 2E 30       2953            DC.B    30H,2EH,30H,30H,2EH,30H,30H,20H
00286A 30 30 2E       2954 BKINIT     DC.B    30H,30H,2EH,30H,30H,2EH,30H,32H
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002872 2E 30 32     2955          DC.B    2EH,30H,32H,2EH,30H,30H,30H,30H
00287A 31 30 37     2956 DKINIT   DC.B    31H,30H,37H,2EH,31H,30H,30H,2EH
002882 31 30 2E     2957          DC.B    31H,30H,2EH,30H,36H,2EH,33H,35H
                    2958
00288A 1000         2959 HEADR    DC.W     1000H          TEST NUMBER
00288C 2000         2960          DC.W     2000H          SITE NUMBER
00288E 3000         2961          DC.W     3000H          SERIAL NUMBER
002890 4000         2962          DC.W     4000H          TIMER 1 FLAG
002892 03E8         2963          DC.W     03E8H          TIMER 1 DEFAULT VAL.
002894 5000         2964          DC.W     5000H          TIMER 2 FLAG
002896 03E8         2965          DC.W     03E8H          TIMER 2 DEFAULT VAL.
002898 600A         2966          DC.W     600AH          PEAK PERIOD DEFAULT
00289A 7000         2967          DC.W     7000H          TRIGGER 2 FLAG
                    2968 *        DC.W     800CH          TRIGGER 2 DEFAULT VAL.
00289C 8012         2969          DC.W     8012H          % TRIGGER 2 DEFAULT VAL.
00289E 8000         2970          DC.W     8000H          TRIGGER 3 FLAG
0028A0 8028         2971          DC.W     8028H          TRIGGER 3 DEFAULT VAL.
0028A2 9006         2972          DC.W     9006H          PEAK SLOPE DB VALUE
0028A4 A023         2973          DC.W     0A023H         PEAK SLOPE TIME VAL.
0028A6 0000         2974          DC.W     0              MIN/SEC INIT VAL.
0028A8 0000         2975          DC.W     0              DAY/HOUR INIT VAL.
0028AA 0000         2976          DC.W     0              YEAR/MONTH INIT VALUE
             <28AA> 2977 ENDHED   EQU      *-2            END OF HEADER INFO
0028AC 00           2978 CLKTB    DC.B     0              SECONDS UNITS
0028AD 10           2979          DC.B     10H                    TENS
0028AE 20           2980          DC.B     20H            MINUTES UNITS
0028AF 30           2981          DC.B     30H                    TENS
0028B0 40           2982          DC.B     40H            HOURS UNITS
0028B1 50           2983          DC.B     50H                  TENS
0028B2 70           2984          DC.B     70H            DAYS UNITS
0028B3 80           2985          DC.B     80H                 TENS
0028B4 90           2986          DC.B     90H            MONTH UNITS
0028B5 A0           2987          DC.B     0A0H                 TENS
0028B6 B0           2988          DC.B     0B0H           YEAR UNITS
0028B7 C0           2989          DC.B     0C0H                 TENS
0028B8 0000         2990 ROMCS    DC.W     0
                    2991          END

Errors=     0
```

```
LINE#  SYMBOL        TYPE   REFERENCES

 ***   A                U  191,192,224,234,247,328,645,675,678,681,682,685,690,
                           847,857,858,1018,1128,1147,1150,1398,1472,2002,2328
                           2380,2389,2721
1589   A04              A  1586
1593   A05              A  1590
1597   A06              A  1594
1601   A07              A  1598
1605   A08              A  1602
1625   A10              A  1622
1629   A11              A  1626
1609   AA               A  1606
1613   AB               A  1610
 ***   ACCEPT           U  1764
1636   ACLEAR           A  1516
 117   ACNTL            A  456,460
 ***   ACTIVE           U  881,910,911,914,942,943,946,1396,1681,1927,2167
1617   AD               A  1614
 115   ADATA            A  462,1133,1152,1164,1167,1188,1204,1287,1292,2375
 112   ADC              A  646,847
 ***   ADD              U  878
 ***   ADDED            U  2433,2434
1364   ADDERR           A  318
 116   ADDR             A  229,313,392,410,458,1445,1468,1496,1646,1654,
                           1655,1683,1840,1871,1872,1929,2038,2169,2332
 ***   ADDRESS          U  241,318,434,435,455,569,1127,1185,1190,1195,1198,1286,1318,
                           1322,1342,1346,2089,2090
 ***   ADDRESSES        U  1469
 128   ADENA            A  644,645
 212   ADMSG            A  597,690
 235   ADSPFLG          A  602,668,854,1452,1956
 234   ADVAL            A  675,678,682,685,688
1621   AE               A  1618
1532   AENT             A  1520
1653   AENTER           A  1530
 ***   AGAIN            U  407,792,797,1142,2348
 224   AKDATA           A  485,1220,1644
1514   AKEY             A  256,1399
2952   AKINIT           A  486
 701   ALCHAR           A  698
 ***   ALL              U  1130,1715
 253   ALPHA            A  253,697,701,1430,1494,1494,1684,1684,1930,1930,2170,2170,
                           2384,2387,2389,2391
1006   AMBAVG           A  865,969
 962   AMBIENT          A  869
 ***   AN               U  1337,1527,1716,1934,2174
 ***   ANALYZE          U  1032
 ***   AND              U  512,887,1398,1643,1687,1848,2252,2630
 ***   ANOTHER          U  878
***   ANSWER        U  1872,1873,2090,2091
***   ANSWERS       U  1655,1874,1875,2092
***   ANY           U  468,1764,2016
***   ARE           U  1487
***   AREA          U  197,198,248
***   ARRAY         U  509,1220,1849,2047
***   AS            U  417,2002
***   ASCII         U  681,684,687,689,741,748,756,1848,2252,2330,2615,2643
***   AT            U  1475,1482,1489,2527
 141  AUTOV1        A
 142  AUTOV2        A
 143  AUTOV3        A
 144  AUTOV4        A
 145  AUTOV5        A
 146  AUTOV6        A
 147  AUTOV7        A
***   AUTOVECTOR    U  327
***   AVERAGE       U  198,631,664,2606
***   AVG           U  969,1006,1071,1093,1098,1103,1108
***   B             U  185,186,187,188,189,190,191,192,193,193,194,194,195,
                       208,209,211,212,213,214,220,221,222,224,225,225,226,
                       227,246,247,414,456,457,458,459,460,461,462,463,464,
                       465,466,467,478,479,480,481,482,483,488,571,573,574,
                       576,578,579,580,581,582,583,584,586,588,589,590,591,
                       640,644,645,647,699,701,702,703,737,741,748,749,756
                       757,758,765,766,767,768,1018,1021,1022,1128,1129,1130,
                       1131,1132,1133,1137,1138,1139,1140,1142,1143,1144
                       1148,1149,1150,1151,1152,1153,1154,1161,1164,1167,1186,
                       1187,1188,1195,1197,1198,1201,1202,1204,1205,1206
                       1209,1211,1212,1221,1227,1228,1229,1230,1231,1232,1233,
                       1234,1235,1236,1237,1238,1239,1240,1241,1242,1243
                       1244,1245,1246,1247,1248,1249,1250,1251,1252,1253,1254,
                       1255,1256,1257,1258,1259,1260,1261,1262,1263,1264
                       1265,1266,1267,1268,1269,1270,1271,1272,1274,1275,1276,
                       1277,1278,1279,1280,1281,1282,1283,1286,1287,1290
                       1291,1292,1318,1320,1322,1324,1342,1344,1346,1348,1400,
                       1445,1479,1496,1646,1683,1687,1689,1691,1693,1695
                       1697,1840,1852,1853,1855,1856,1857,1860,1861,1863,1864,
                       1866,1867,1869,1870,1929,2038,2050,2051,2053,2054
                       2056,2057,2058,2060,2061,2063,2064,2066,2067,2068,2070,
                       2071,2073,2074,2075,2077,2078,2080,2081,2082,2084
                       2085,2087,2088,2169,2254,2260,2263,2264,2272,2273,2274,
                       2275,2330,2332,2334,2343,2346,2347,2348,2352,2375
                       2378,2402,2405,2428,2429,2430,2617,2618,2619,2645,2646,
                       2647,2665,2678,2679,2680,2684,2689,2691,2692,2693
                       2694,2722,2935,2936,2937,2938,2939,2940,2941,2942,2943,
                       2944,2945,2946,2947,2948,2949,2950,2951,2952,2953
                       2954,2955,2956,2957,2978,2979,2980,2981,2982,2983,2984,
                       2985,2986,2987,2988,2989
***   B02           U  2798
***   B2             U  2746
1776  B4             A  1772
1781  B6             A  1777
1786  B7             A  1782
1791  B9             A  1787
1796  BA             A  1792
***   BACK           U  793,2351,2508,2562
1410  BADFTN         A
 150  BARKER         A  493,493,494,495,496,497,505,505,506,507,1710,1711,1712,
                        1923,1924,1925,2156,2157,2158,2607,2607,2608,2609
***   BASE           U  1468
***   BAT            U  348,428,648,977,1036,1305,1698,1895,2129,2656
***   BATTERY        U  490,1317
1801  BC             A  1797
1831  BCLEAR         A  1736
 120  BCNTL          A  457,464,645,1021,1129,1132,1148,1153,1187,1206
1806  BD             A  1802
 118  BDATA          A  466,647,1022,1161,1286,1290
 119  BDDR           A  459,1130,1149
***   BE             U  1108,1317,1520,1527,1740,1985,1989,1996,2013,2016
 343  BEAR           A  316,320
***   BEFORE         U  2488,2563
***   BEGIN          U  2490
***   BEGINNING      U  256,268,280,726,2527
1746  BENT           A  1740
1847  BENTER         A  1744
***   BIT            U  378,386,390,906,938,950,1080,1154,1209,2346
***   BITS           U  460,1130,1140,1213,1214,1291,2331
 225  BKDATA         A  1838,1850
1734  BKEY           A  268,1401
2954  BKINIT         A
***   BLANK          U  593,597
***   BLANKING       U  1414
 149  BLNK           A  593,594,595,596,598,599,600,601
***   BLOCK          U  181
 436  BLOOP          A  441
***   BOD            U  2491
***   BOE            U  2488
2946  BOMMSG         A  548
***   BOOM           U  206,207,208,550,772,2601,2613,2641
 236  BOOMFLG        A  611,1337,1414,1416,1420
1420  BOOMON         A  1415
 208  BOOMSG1        A  549,772,1417,1453,2616,2620,2648
 209  BOOMSG2        A  2644
2543  BOTCONT        A  2550
2551  BOTFND         A  2545
 202  BOTRAT         A  626,1079,1093,1098,1103
***   BOTTOM         U  202
***   BOUNDARY       U  373
***   BOUNDRY        U  247
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1396 BRAFTN        A  1385,1433
  97 BRAM          A  410,411,417,428,434,438,471,490,498,1037,1705,1718,1881,2176
 428 BRAMDIG       A  412
  96 BRAMON        A  348,648,977,1036,1305,1698,1718,1895,1936,2129,2176,2656
2945 BRAMSG        A  1317
***  BRANCH        U  2344,2349
 431 BRMWRT        A  433
1810 BS1           A  1807
1816 BS2           A  1811
1820 BS3           A  1817
1824 BS4           A  1821
***  BUF           U  592,703
***  BUFFER        U  211,593,734,769
***  BUFFERS       U  1476,1483,1490
***  BUMP          U  519,523,531,535
***  BUS           U  317
1363 BUSERR        A  317
***  BY            U  860,1467
***  BYTE          U  1215,1320,1322,1344,1346,2332,2351
***  C             U  1402
***  C5A           U  2799
***  C8            U  2747
***  CAL           U  211,212,217,218,219,234,235,592,597,602,638,639,670,734,769,
                      770,771,773,774,775,849,851,1452,1946,1948 1954,1956,1961
 742 CAL1          A  739
 743 CAL2          A  747
 748 CAL2A         A  744
 751 CAL3          A  755
 756 CAL3A         A  752
 760 CAL4          A  764
 765 CAL4A         A  761
***  CALC          U  603,723,725,2594
 719 CALDSP        A  671
 773 CALEND        A  771
 217 CALFLG        A  637,670,770,849,1451,1952,1957
 732 CALFND        A  728
***  CALIBRATION   U  637,1402,1451,1952
1952 CALMD1        A  1947
1956 CALMD2        A  1949
 211 CALMSG        A  592,734,769
 727 CALOP         A  730
2947 CALPRMT       A  1960
1960 CALRET        A  1945
 218 CALSUM        A  638,722,774,862,1953
 219 CALTIM        A  639,673,692,720,775,851,853,1954,1958
***  CC            U  2748
***  CHAR          U  697,703
***  CHARACTER     U  246,253,254,1319,1325,1343,1349
***  CHECK         U  374,376,393,399,403,406,411,432,440,442,720,849,851,
                      889,910,942,1015,1080,1309,1313,1414,1944,2348,2622
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***   CHECKSUM        U  376
***   CHK             U  897
2001  CHK6            A  1995
1994  CHK7            A  1988
1573  CHKA10          A  1567
1552  CHKA7           A  1546
1559  CHKAA           A  1553
1566  CHKAD           A  1560
2494  CHKCONT         A  2489
2522  CHKFPK          A  2498,2505,2516
 889  CHKNPK          A  886
1943  CKEY            A  1403
***   CLEAR           U  456,602,637,640,1084,1436,1443,1444,1446,1451,1452,
                         1470,1474, 1481,1488,1492,1493,1494,1495,1497,1515
                         1684,1685,1735,1930,1931,1978,2170,2171,2299,2653,2654
1476  CLEARA          A  1477
1483  CLEARB          A  1484
1490  CLEARD          A  1491
***   CLEARED         U  1682,1928,2168
***   CLEARING        U  1475,1482,1489
***   CLK             U  1217
 182  CLK1            A  502,545,1208,1707,1920,2153,2603
 183  CLK2            A  503,546,1708,1921,2154,2604
 184  CLK3            A  504,547,1709,1922,2155,2605
2978  CLKTB           A  1135,1190
***   CLOCK           U  478,484,775,1133,1137,1292,1686
***   CLOSE           U  791
***   CMPR            U  384,388
***   CNTROL          U  1148
***   CNVRT           U  2485
***   CODE            U  250,252,511,1432,1944
***   CODES           U  493,505,2607
1211  COMBIN          A  1218
***   COMBINE         U  1201,1216
***   COMMAND         U  192,194,1287,1515,1529,1735
 410  COMBRAM         A  408
 885  CONEVNT         A  882
2601  CONFND          A  2438,2493,2521
 879  CONSAV          A  873
2613  CONT1           A  2611
2620  CONT1A          A
2641  CONT2           A  2639
1719  CONTA           A  1717
***   CONTAINS        U  180
1937  CONTB           A  1935
2177  CONTD           A  2175
2387  CONTIN          A  2385
***   CONTINUE        U  850,917,1081,1203,1338,2528
***   CONTROL         U  456,460,464,1135,1140,1144,1187,1206
***   CONVERSION      U  220,699,701
***   CONVERT         U  572,577,681,684,687,689,743,748,751,756,761,767,1848,2251,2330,2615,2643
***   CONVERTED       U  292
***   CORRECT         U  1469
 254  COUNT           A  206,207,208,254,492,550,573,578,580,978,1191,1319, 1325,
                         1343,1349,1444,1444,1495,1495,1514,1514,1517,1519
                         1521,1523,1525,1527,1545,1552,1559,1566,1573,1585,1589,
                         1593,1597,1601,1605,1609,1613,1617,1621,1625,1682
                         1682,1734,1737,1739,1741,1756,1758,1760,1762,1771,1776,
                         1781,1786,1791,1796,1801,1806,1810,1816,1820,1928
                         1928,1943,1944,1977,1977,1981,1984,1987,1994,2001,2004,
                         2007,2010,2013,2168,2168,2183,2188,2193,2198,2203
                         2208,2213,2218,2223,2228,2233,2613,2641,2645,2649
***   COUNTER         U  203,204,736,853,872,883,985,1082,1136,1734
***   COUNTS          U  173,175,177,178,179
***   COUTER          U  1210
***   CUR             U  994
 198  CURAVG          A  1380,2166
 197  CURPNT          A  619,1379,1705,1713,1901,1926,2133,2164,2250,2360,2629
***   CURRENT         U  197,198,502,630,874,1379,1643,1738,2250,2602,2603
 696  CVTAD           A  681,684,687,689
***   D               U  226,234,328,645,675,678,681,682,685,690,847,857,858,
                         1018,1404,1486,2048,2723
2188  D04             A  2184
2193  D05             A  2189
2198  D07             A  2194
2203  D08             A  2199
2208  D09             A  2204
2233  D11             A  2229
2238  D12             A  2234
 844  DAC             A  328
 864  DACCONT         A  850
1014  DACRET          A  852,855,863,867,880,908,913,915,931,940,945,947,955,999,1033
***   DATA            U  191,193,197,224,225,226,256,268,280,402,403,411,436,
                         462,466,484,628,629,847,871,885,897,907,909,918,939
                         941,965,967,994,995,996,1007,1032,1072,1073,1149,1150,
                         1152,1290,1320,1323,1344,1347,1379,1408,1654,1740
                         1848,1871,1875,1881,1985,2048,2089,2250,2351,2446,2527
***   DATE            U  1398,1643,1687
 213  DATMSG          A  676
 233  DATSAV          A  636,879,963,2285,2431,2652
 294  DAY             A  183,260,294,478,481,501,502,546,1521,1554,1603,1607,1690,2975
 188  DAY1            A  481,1244,1249,1691
***   DAYS            U  188,2984
2213  DB              A  288,306,539,724,725,726,732,733,2209,2494,2499,
                         2505,2507,2518,2579,2592,2594,2751,2972
2822  DBHEX           A  725,726,2104,2109,2115,2495,2499,2508,2510,2571,2572,2580,2582
2932  DBLEN           A  724,2103,2114,2494,2509,2570,2581
2711  DBTAB           A  732,2102,2506,2517,2578,2592
***   DBTABLE         U  2506,2517
2218  DC              A  2214
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2029  DCLEAR        A  1979
***   DDC           U  2800
2415  DDLOOP        A  2416
2223  DE            A  2219
***   DECIMAL       U  220,255,1497,1685,1756,1758,1760,1762,1931,2002,
                       2171,2252,2296,2299,2328,2380,2615,2643
2295  DECPTS        A  1522,1524,1526,1757,1759,1761,1763,2002,2005,2008,2011
***   DECR          U  729,853,872,1082,1325,1349,2504,2515
***   DECREASING    U  899
***   DECREMENT     U  883
***   DEFAULT       U  498,2963,2965,2966,2969,2971
1359  DELAY         A  350,634,978,979,979,1080,1082,1160,1163,1166,1192,1193,
                       1289,1359,1699,1700,1700,1703,1896,1897,1897,2130
                       2131,2131
1851  DENLP         A  1858
2105  DENLP1        A  2108
2116  DENLP2        A  2119
2020  DENT          A  1985
2045  DENTER        A  2014
2228  DF            A  2224
 168  DHTIM         A
***   DIAG          U  468
***   DIAGNOSTIC    U  205
***   DIAGNOSTICS   U  1306
***   DIF           U  2519
***   DIFFERENCE    U  2251,2594
***   DIG           U  1587,1591,1595,1599,1603,1607,1611,1615,1619,1623,1629,1810,1812,1816,1820,1824
***   DIGIT         U  736,737,743,748,751,756,761,767,1547,1554,1561,1568,
                       1575,1627,1756,1758,1760,1762,1764,1773,1778,1783
                       1788,1793,1798,1803,1806,2016,2185,2190,2195,2200,2205,
                       2210,2215,2220,2225,2230,2235,2238,2389,2617,2618,2619
 248  DIGITS        A  1873,2091,2308,2316
***   DIR           U  1128,1147
***   DIRECTION     U  458,1129
***   DISABLE       U  582,2429
***   DISPLAY       U  211,212,246,251,485,597,612,676,690,703,771,772,773,
                       866,1220,1307,1323,1339,1347,1414,1436,1445,1446
                       1447,1450,1457,1496,1588,1592,1596,1600,1604,1608,1612,
                       1616,1620,1624,1628,1630,1646,1683,1738,1774,1779
                       1784,1840,1849,1929,1961,2038,2047,2169,2186,2191,2196,
                       2211,2216,2221,2226,2231,2236,2239,2253,2332,2334
                       2342,2616,2621,2649
***   DISPLAYED     U  1037
***   DISPLQY       U  2201
 113  DISPLY        A  2342,2399
 135  DIST2         A  583,584
***   DIVIDE        U  860,1074,1075
 226  DKDATA        A  2036,2048
1977  DKEY          A  280,1405
2956  DKINIT        A
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 662  DLOOP         A  664
***   DO            U  407,792,797
***   DON           U  2328
***   DOWN          U  1143
2935  DSLIST        A  2400
 246  DSPADR        A  1318,1322,1324,1342,1346,1348,1445,1496,1646,1683,1840,
                       1929,2038,2169,2332,2334
1342  DSPCONT       A  1338,1340
2413  DSPDEL        A  2345,2350,2404
1344  DSPMLP        A  1349
1337  DSPMSG        A  666,691,773,1038,1418,1454,1471,1645,1839,1961,2037,
                       2277,2287,2621,2649
1450  DSPOFF        A
1457  DSPON         A  1448
 247  DUMMY         A
***   DURATION      U  203,204
***   DURING        U  218
***   E             U  1406,2724
***   E0            U  2752
***   E5            U  2753
***   EA            U  2754
***   EIGHTH        U  2203
1108  EIGHTSEC      A  1104
2249  EKEY          A  1407
2255  EKEY1         A  2259
2260  EKEY1A        A  2256
2265  EKEY1B        A  2262
2267  EKEY2         A  2271
2272  EKEY2A        A  2268
***   ELSE          U  413,473,699,772,853,878,887,899,913,918,926,945,948,
                       949,969,1079,1936,2504,2515,2624
 339  EMPTY         A
***   ENABLE        U  590,642,645
***   END           U  240,371,374,380,393,396,399,406,432,435,438,440,720,
                       724,851,877,1015,2249,2622,2977
1031  ENDBOOM       A  877,884,1016
  98  ENDBRM        A  429,435,1015,2249,2433,2622
  99  ENDDATA       A  2636
2977  ENDHED        A
1039  ENDLES        A  1040
***   ENDLESS       U  1040
  93  ENDPRM        A  371
 442  ENDRAM        A  438
 107  ENDRAT        A  396,1077
  95  ENDSRM        A  380
 409  ENDTST        A  404
 240  ENDVAR        A  415,2666
***   ENOUGH        U  916,2441
***   ENTER         U  1740,1743,1985
***   ENTERED       U  249,250,253
***   ENTRIES        U  1738
***   ERASE          U  2442
***   ERR            U  377,1469
2948  ERRMSG         A  1468
 252  ERRNUM         A  1410,1466,1470,1470,1549,1556,1563,1570,1577,1950,1991,1998
1465  ERROR          A  252,317,318,378,386,390,468,1309,1313,1315,1317,1411,
                        1435,1466,1468,1533,1544,1550,1557,1564,1571,1578
                        1747,1765,1813,1951,1992,1999,2018,2021,2046,2297
***   EVENT          U  203,229,877,966,968,1337,1716,1934,2174,2442,2490,2563,2577,2591,2600
***   EVERYTHING     U  247
 203  EVNTCNT        A  872,878,925,988
***   EXIT           U  1096,1101,1106,1339,2630
***   EXTRA          U  1213,1214,1291
***   F              U  1408
***   F0             U  2755
***   F5             U  2756
***   F8D            U  2801
***   FAILED         U  404,409,444,731
 946  FALL1          A  942
 938  FALLING        A  899
***   FB             U  2757
***   FETCH          U  402
***   FIELDS         U  2001
***   FIFTH          U  2193
***   FILL           U  593
***   FIND           U  1433,2526
***   FIRST          U  381,493,737,1211,1517,1547,1554,1561,1568,1575,1587,
                        1595,1603,1611,1619,1627,1737,1773,1783,1793,1803
                        1981,2185,2200,2215,2225,2235,2526,2530,2535,2555,2568,2592
2285  FKEY           A  1409
***   FLAG           U  215,217,235,251,255,417,519,523,531,535,637,1443,
                        1451,1452,1492,1494,1684,1930,1952,2170,2653,2654,2962
                        2964,2967,2970
***   FLAG1          U  868,2447
***   FLAG2          U  949,2447
***   FLAG3          U  868,870,994
***   FLAG4          U  888
***   FLAGS          U  2624,2631
***   FLG            U  602,1956
2538  FNDBOT         A  2535
2531  FNDPK          A  2537,2554
2529  FNDST          A  2526
***   FOLLOWS        U  1521,1523,1525
***   FOR            U  197,198,203,204,234,248,374,393,399,406,432,440,442,
                        622,626,641,663,693,720,794,849,851,985,1015,1074
                        1080,1149,1190,1191,1203,1210,1309,1313,1414,1577,1699,
                        1896,1944,2130,2622
***   FOUND          U  728,2502,2513,2535
***   FOUR           U  1137
1103  FOURSEC        A  1099
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***   FOURTH          U  2188
2567  FPCONT          A  2564
2578  FPFND           A  2574
2573  FPLOP           A  2576
2592  FPSFND          A  2588
2587  FPSLOP          A  2590
***   FROM            U  180,486
***   FULL            U  1037
2942  FULLMSG         A  1037
***   FUNC            U  1944
 250  FUNCT           A  1396,1398,1400,1402,1404,1406,1408,1432,1443,1472,
                         1479,1486,1492,1681,1681,1927,2167
***   FUNCTION        U  224,225,226,250,1396,1432,1433,1443,1472,1479,1486,1492,1927,2048,2167
***   FUNCTIONS       U  1487
***   GET             U  370,371,379,380,395,396,401,410,434,455,490,491,501,
                         510,513,516,534,538,539,542,545,546,547,569,570,575
                         675,678,682,685,688,724,847,857,1134,1135,1138,1139,
                         1142,1185,1189,1190,1196,1198,1199,1207,1211,1212
                         1290,1311,1315,1320,1322,1344,1346,1381,1643,1875,2249,
                         2335,2343,2428,2481,2482,2484,2494,2496,2506,2507
                         2518,2519,2524,2531,2556,2568,2579,2592,2597,2602
1430  GETFTN          A  1397
2371  GETKEY          A  1381
 897  GETSLOP         A  890
***   GETY            U  327
***   GO              U  1032,1078,1141,1145,1323,1347,2526
***   GOES            U  2505,2516
***   GOOD            U  411,412,417,442
***   GOTO            U  377
***   GRT             U  1127
***   HALF            U  790
***   HALVE           U  788
***   HEADER          U  181,491,508,2977
2959  HEADR           A  491,508
***   HEX             U  2499,2508
2678  HEXCNVT         A  2615,2643
 260  HIDA            A  1603
***   HIGH            U  603,688,909,916,939,965,1200,1215
 262  HIHR            A  1611
 286  HIJV            A  2094,2215
 264  HIMN            A  1619
 258  HIMO            A  1595
 290  HIRT            A  2235
 288  HIRV            A  2225
 266  HISC            A  1627
 270  HISN            A  1783
 272  HIT1            A  1793
 274  HIT2            A  1803
 283  HITR2           A  2200
 280  HITR3           A  1489,1489,2047,2089,2185
 268  HITT             A  1482,1482,1773,1849,1871
 256  HIYR             A  1475,1475,1587,1654
 788  HLFLOP           A  792
 121  HOLD             A  1133,1133,1167,1188,1188,1204,1292,1292
***   HOUNDREDS        U  751
 295  HOUR             A  183,262,295,480,546,1137,1154,1209,1611,1615,1692,2975
 187  HOUR1            A  480,1137,1154,1209,1254,1259,1693
***   HOURS            U  187,1561,2982
***   HRS              U  1523
 220  HUND             A  2617,2645,2678,2684,2692
2681  HUNLP            A  2685
***   I                U  455,569,1127,1185
***   IF               U  377,412,438,468,470,670,671,697,721,731,738,770,791,
                          792,796,797,850,852,866,873,877,881,884,898,907,909
                          910,911,914,939,941,942,943,946,1081,1146,1337,1339,
                          1384,1397,1431,1432,1448,1518,1716,1934,2174,2328
                          2344,2349,2441,2446,2488,2505,2516,2563,2577,2591,2599,2623
***   IN               U  173,175,177,178,179,493,498,505,550,670,703,770,799,
                          996,1007,1073,1074,1195,1202,1217,1337,1705,1716
                          1849,1934,2174,2332,2507,2516,2562,2577,2591,2607,2616,2645
 793  INCLOP           A  797
***   INCR             U  392,742,793,870,994,1076,1324,1348,2601,2613,2641
***   INCREMENT        U  1514,1734,1977,2334
***   INDEX            U  1324,1348
 181  INFEND           A
***   INFO             U  180,485,491,508,1400,2977
 498  INILP            A  500
 455  INIPIA           A  418,443
***   INIT             U  381,382,471,626,633,638,639,663,864,1084,1319,1343,1686,2974,2975,2976
2398  INITDS           A  612,1307,1421,1436,1446,1534,1636,1748,1831,2022,2029,2435
2402  INITDS1          A  2403,2406
***   INITIAL          U  486,787
***   INITIALIZATION   U  641
***   INITIALIZE       U  418,478,612,622,1307
***   INPUT            U  195,859,1381,1430,1434,1577,2327,2333,2335
***   INTERRUPT        U  328,329,645,1018
***   INTERRUPTS       U  590,642,693
***   INTO             U  509,1200,1466,1881,2253,2327
***   IRQ              U  331,332
 125  IRQEN            A  590,591,2429,2430
***   IS               U  438,864,866,876,1447,1472,1479,1486,1543,1545,1756,1758,
                          1760,1762,1813,1946,1948,2296,2380,2384,2387,2389,2520
1543  ISDIGA           A  1528
1756  ISDIGB           A  1742
1837  ISSTAT           A  1738
1642  ISTIME           A  1518
2035  ISVAL            A  1982
***   IT               U  864,1128,1147,1150,1946,1948
 305  JMPVAL           A  2095,2122
***   JUMP             U  286,305
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 488  KDATIN        A  489
 249  KEY           A  249,331,1382,1386,1432,1434,1444,1493,1493,1495,1515,
                       1517,1519,1529,1532,1543,1543,1545,1547,1552,1554
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                       2188,2190,2193,2195,2198,2200,2203,2205,2208,2210,2213,
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                       2298,2327,2328,2333,2379,2380,2380,2384,2384,2387,2387,2389
***   KEYBOARD      U  195,252
 195  KEYIN         A
2936  KEYLIST       A  2374
***   KEYPAD        U  254
1377  KEYPD         A  331
2358  KEYRET        A  1388,1419,1422,1437,1455,1458,1498,1535,1647,1719,1749,1841,
                       1937,1955,1959,1962,2023,2039,2177,2278,2289,2335
***   KEYS          U  1764,2016
***   KEYSTROKE     U  1514,1734,1977
***   L             U  197,199,200,201,202,203,204,218,229,237,238,315,316,
                       317,318,319,320,321,322,323,324,325,326,327,328,329
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                       623,624,625,626,627,628,629,630,631,632,633,638,643
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                       846,856,858,861,862,868,870,872,874,875,876,878,883,
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                       922,923,924,925,939,941,949,954,965,967,983,986,987,
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                       2165,2172,2249,2250,2251,2253,2266,2276,2286,2307
                       2309,2315,2318,2326,2341,2342,2353,2359,2360,2361,2362,
                          2363,2372,2373,2374,2376,2377,2398,2399,2400,2407
                          2413,2417,2426,2427,2433,2436,2437,2439,2441,2446,2448,
                          2453,2454,2459,2461,2465,2466,2467,2469,2470,2475
                          2479,2480,2481,2485,2486,2487,2488,2490,2491,2492,2494,
                          2495,2499,2503,2506,2508,2509,2510,2514,2517,2522
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                          2566,2567,2570,2571,2572,2575,2578,2580,2581,2582,2583,
                          2584,2586,2589,2592,2595,2596,2601,2616,2620,2622
                          2624,2625,2626,2627,2628,2629,2631,2632,2633,2634,2635,
                          2636,2644,2648,2650,2651,2657,2662,2663,2664,2666,2668
2343  LAB1              A 2344
2348  LAB2              A 2349
***   LARGER            U 898
***   LAST              U 229,250,253,473,629,916,1714
***   LCD               U 2342
***   LE                U 2520
***   LEFT              U 214,556,1406,2331
***   LENGTH            U 725,2494
***   LETTER            U 1430
***   LIGHTNING         U 329
2698  LITNG             A 329
***   LOAD              U 397,485,492,676
***   LOCATION          U 246,391,875
 261  LODA              A 1607
 263  LOHR              A 1615
 287  LOJV              A 2220
 265  LOMN              A 1623
 259  LOMO              A 1599
***   LOOP              U 776,1040
 291  LORT              A 2238
 289  LORV              A 2230
 267  LOSC              A 1629
 271  LOSN              A 1788
 273  LOT1              A 1798
 275  LOT2              A 1808
 285  LOTR2             A 2210
 282  LOTR3             A 2195
 269  LOTT              A 1778
***   LOW               U 603,907,941,967,1201
***   LOWER             U 1139,1198,2332,2351
 257  LOYR              A 1591
***   LSB               U 678
 229  LSTEVT            A 473,618,1714,1932,2172,2628,2631
***   MAKE              U 1128,1130,1147,1150
***   MASK              U 381,382,383,384,387,397,398,411,430,511,696,861,1213,1214,1291
***   MATCH             U 728,796,2513
***   MAX               U 1813
***   MAY               U 2016
***   MEAN              U 723
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1313  MEM1          A  1310
1317  MEM2          A  1314
1320  MEM3LP        A  1325
1305  MEMERR        A  469
 214  MEMMSG        A  557,2253,2276
 ***  MEMORY        U  205,214,391,556,1406,2249
1318  MEMSG         A  1312,1316
 205  MEMSTAT       A
1326  MEMSTP        A  1327
2941  MEMTEXT       A  556
 ***  MESSAGE       U  214,492,592,769,773,1037,1311,1315,1468,1881,2621,2649
 ***  MIDDLE        U  735
 ***  MIN           U  182,545,2974
 186  MIN1          A  479,1264,1269,1695
 296  MINUTE        A  264,296,1694
 ***  MINUTES       U  186,479,1525,1568,1619,1623,2980
 284  MITR2         A  2205
 281  MITR3         A  2190
 ***  MODE          U  217,670,770,849
 293  MONTH         A  184,189,258,293,482,547,1547,1595,1599,1688,2976,2986
 189  MONTH1        A  482,1235,1240,1689
 ***  MORE          U  1146
 ***  MOVE          U  413,473,550,556,1074,1215,1881,2327,2562,2607
 ***  MOVING        U  632
 ***  MS            U  876,878
 ***  MSB           U  685
 ***  MSEC          U  639,2485
 ***  MSG           U  208,211,212,550,556,597,676,734,735,742,771,772,1469,2253,2616,2645
 241  MSKOFF        A  411
 167  MSTIM         A
 232  MSTRST        A
 ***  MULT          U  248
2310  MULTI         A  2312,2317
2306  MULTIPL       A  1875,1880,2093,2098
 ***  MULTIPLY      U  1467,1875
 ***  MUST          U  1108,1317,2013
 ***  N             U  1810,1813,1816,1820,1824,1859,1862,1865,1868
 ***  NE            U  438
 ***  NEG           U  238,889
2458  NEGCHK        A  2456,2464
2479  NEGCHK1       A  2451
 ***  NEGITIVE      U  201,633
 201  NEGPK         A  633,889,891,924,998,2466,2651
2465  NEGPKCHK      A
2474  NEGPLP        A  2478
 ***  NEW           U  871,885,897,907,909,939,941,965,966,967,968,1007,1072,
                       1687,1705,1740,1985,2048
 ***  NEWEST        U  628
 976  NEWEVT        A  964,966,968
 ***  NEXT          U  400,505,682,1198,2335,2531
***   NIBBLE          U  682,688,696,1139,1143,1198,1200,1201
***   NO              U  298,299,302,412,860,877,886,1078,1094,1099,1104,1388,
                         1487,1681,1927,2167,2442,2505,2521,2528,2536
***   NOISE           U  969
***   NON             U  207,470,2384,2577,2591,2600,2641
1492  NONERON         A  1478,1485,1487
2631  NONEVNT         A  2442,2447,2462,2468,2476,2533,2549,2577,2591,2600
 478  NONRST          A  471
***   NOT             U  377,721,792,797,850,911,914,943,946,1337,1384,1397,
                         1431,2344,2349,2516,2577,2591
1434  NOTFTN          A  1431
2384  NOTPT           A  2381
 170  NUL             A  319,319,319,319,321,321,321,323,326,327,330,333,334,336,337,338
***   NUM             U  699
***   NUMBER          U  269,270,276,510,513,516,1773,1778,1783,1788,2959,2960,2961
***   NUMERIC         U  2384
 207  NVBOOM          A  555,2638,2640,2641,2642
2553  NXTPK           A  2547
***   O               U  455,569,1127,1185
***   OD              U  682
***   OF              U  202,205,240,256,268,280,313,316,320,327,370,371,374,
                         379,380,395,399,401,406,428,438,458,464,478,490,501
                         502,663,678,685,720,723,724,725,726,735,851,860,877,
                         1015,1077,1189,1207,1547,1554,1561,1568,1575,1587
                         1591,1595,1599,1603,1607,1611,1615,1619,1623,1627,1629,
                         1654,1655,1773,1778,1783,1788,1793,1798,1803,1806
                         1810,1816,1820,1824,1871,1872,1873,1874,2089,2090,2091,
                         2092,2185,2190,2195,2200,2205,2210,2215,2220,2225
                         2230,2235,2238,2249,2490,2494,2519,2527,2560,2579,2592,
                         2622,2977
 251  OFF             A  251,255,511,648,696,861,866,1036,1081,1204,1213,1214,
                         1291,1305,1339,1339,1382,1384,1447,1447,1450,1450
                         1457,1718,2176,2288,2656
1443  OFFON           A  1383
***   OFFSET          U  241,858
***   OLD             U  897,996,1007,1071
***   ON              U  247,251,255,348,373,866,950,977,982,1140,1144,1382,
                         1457,1472,1479,1486,1487,1698,1895,2129,2296,2346
1093  ONESEC          A  1078,1081,1083,1085
***   ONLY            U  1577
***   OR              U  1317,1382,1989,1996
***   OTHER           U  464,1764,2016,2518,2519
***   OUT             U  1476,1483,1490,2333
***   OUTPUT          U  1129,1130,1141,1145,1148,1i49,1187,1206,1286,1287
***   PAD             U  331
***   PARAMETER       U  1197,2481,2482,2484,2520,2556,2597,2599
***   PARAMETERS      U  240,410,413,471,1191,1210,1715
2665  PARLOP          A  2667
***   PASSED          U  408,443
***   PAST            U  519,523,531,535
***   PEAK            U  201,539,542,630,633,638,875,876,885,887,888,889,916,
                         2215,2220,2441,2486,2496,2502,2507,2519,2523,2524
                         2525,2525,2526,2535,2555,2568,2579,2650,2966,2972,2973
***   PERIOD          U  219,639,720,851,853,1954,2215,2220,2966
2506  PFIND           A  2502
 114  PIA             A  418,455,643,1017,1127,1185,2372
2524  PKEND           A  2528
2555  PKFND           A  2552
2501  PLOOP           A  2504
***   PNTR            U  742,888,2250,2491,2505
 255  POINT           A  255,592,726,732,734,735,769,949,995,1497,1497,1521,
                         1523,1525,1685,1685,1931,1931,2171,2171,2296,2296
                         2299,2299,2328,2382,2499,2508,2517,2592
***   POINTER         U  197,392,473,676,729,874,1076,1079,1318,1342,1379,1714,
                         2486,2488,2504,2515,2555,2562,2601
***   POINTERS        U  918
***   POP             U  2353
***   PORT            U  191,192,193,194,455,458,464,1127,1128,1147,1150,1185
 192  PORTAC          A  461
 191  PORTAD          A  463
 194  PORTBC          A  465,644,1018,1128,1129,1131,1132,1147,1148,1150,1151,
                         1153,1186,1187,1205,1206
 193  PORTBD          A  467
***   POS             U  237
***   POSITION        J  2491
***   POWER           U  215,634
***   PREVIOUS        U  2534,2536
***   PROGM           U  332
***   PROGRAM         U  316,320
  92  PROM            A  313,313,370,370,371,373,374
***   PROMPT          U  1961
 140  PRVTRP          A
2512  PSLOOP          A  2515
 165  PSLOP           A  2127,2147,2482,2597
 166  PSLTM           A  2128,2151,2484,2558
***   PT              U  2380
2331  PTFND           A  2329
***   PTS             U  2342
***   PUT             U  493,505,508,799,1195,1705
2325  PUTKEY          A  1588,1592,1596,1600,1604,1608,1612,1616,1620,1624,1628,
                         1630,1774,1779,1784,1789,1794,1799,1804,1809,1815
                         1819,1823,1825,2186,2191,2196,2201,2206,2211,2216,2221,
                         2226,2231,2236,2239,2300
***   PUTS            U  247
***   PWR             U  1080,1082
 216  PWRCNT          A  635,1086,1089
1086  PWRDEL          A  1068
 215  PWRUP           A  634,1067,1082,1088
***   RAM             U  348,379,380,395,413,428,438,487,490,551,557,648,977,
                         1015,1036,1305,1313,1315,1698,1895,2129,2622,2656
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1035  RAMFL        A  2434,2623,2637
1067  RAT          A  202,395,399,401,406,626,641,864,1006,1073,1076,1077,1079,1084,1317
 402  RATLP        A  407
 395  RATRAM       A
 398  RATWRT       A  400
***   RAW          U  2327
1184  RDCLK        A  501,1643,1704,1898,2132,2602
1194  RDCLK1       A  1203
2939  RDYMSG       A  665
***   RE           U  1686
 122  READ         A  384,388,436,1287,1287
1286  READC        A  1196,1199
***   READY        U  2344,2349
***   REAL         U  484,1686
***   REG          U  372
***   REGISTER     U  462,466,2327
***   REGISTERS    U  622,845,1023,2353
 414  RELOAD       A  416
***   REMAINDER    U  861
***   REQUEST      U  1382
***   RESET        U  470,582,774,775,887,888,918,926,948,1018,1079,1154,
                      1209,1445,1496,1646,1683,1840,1929,1953,1954,2038
                      2169,2624,2631
***   RESTORE      U  1023
***   RESULT       U  862
***   RETURN       U  721,731,776,852,863,867,908,913,915,931,940,945,947,955,999,1033,1955
***   RISE         U  288,290,306,307
 914  RISE1        A  910
 306  RISEDB       A  2127
***   RISETIME     U  2225,2230,2235,2238
 307  RISETM       A  2128
 906  RISING       A  898,906
***   ROM          U  487,1309,1311
2990  ROMCS        A
 370  ROMDIG       A
 373  ROMLP        A  375
2943  ROMMSG       A  1311
***   ROOT         U  723,799
***   ROUTINE      U  1433
 926  RST2CON      A  917
 230  RSTFLG       A  417,470
 231  RSTMSK       A  241,620
 916  RSTT2        A  948
***   RTC          U  1188,1190
***   RUN          U  622
***   RUNNING      U  663
***   S            U  1810,1813,1816,1820,1824,1859,1862,1865,1868,2344,2349,2403
***   SAMPLES      U  860,2485
***   SAVE         U  197,198,248,733,787,794,845,874,1073,1197,1202,1306,
                      1379,1408,1587,1591,1595,1599,1603,1607,1611,1615
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                        1619,1623,1627,1629,1714,1715,2486,2523,2530,2555
1585  SAVEA         A   1548,1555,1562,1569,1574,1576
1771  SAVEB         A
2183  SAVED         A   1990,1997,2017
 870  SAVEVT        A
2940  SAVMSG        A   2286
2662  SAVPAR        A   621,1715,1933,2173,2655
***   SEARCH        U   731
***   SEC           U   182,545,626,634,1093,1098,1103,1108,2974
 185  SEC1          A   478,1134,1189,1207,1275,1280,1697
 297  SECOND        A   266,297,382,387,1212,1519,1591,1599,1607,1615,1623,
                        1629,1696,1739,1778,1788,1798,1806,1984,2190,2205
                        2220,2230,2238
***   SECONDS       U   185,1575,1627,1629,2978
***   SECS          U   1577
***   SEE           U   468,670,738,770,791,796,1716,1934,2174,2441,2446,2488,2563
***   SEND          U   588
 155  SERIAL        A   276,302,516,1884,1911,2961
 302  SERNO         A   1877,1884
***   SET           U   378,386,390,430,458,460,464,634,641,906,938,949,950,
                        978,982,985,1136,1137,1149,1191,1210,1318,1342,1432
                        1699,1896,1952,1956,2130,2490,2536
2391  SETALF        A   2388
***   SEVENTH       U   2198
2517  SFIND         A   2513
***   SHIFT         U   1095,1100,1105,1143,1200,2331,2351
***   SHIFTS        U   1078
***   SHOULD        U   1520,1527,1740,1985,1989,1996
 154  SITE          A   270,299,513,1783,1788,1883,1907,2960
 299  SITENM        A   1883
***   SIX           U   1191,1203
 108  SIZE1         A   1093
 109  SIZE2         A   626,627,1098
 110  SIZE3         A   1103
 111  SIZE4         A
 383  SLOOP         A   394
***   SLOPE         U   539,542,899,906,938,2482,2484,2487,2520,2520,2556,2597,2599,2972,2973
 387  SLP1          A   385
 391  SLP2          A   389
 276  SW1           A   1814,1876
 277  SW2           A   1818
 278  SW3           A   1822
 279  SW4           A   1824
***   SO            U   1432,1448,1518
***   SOFT          U   1404
***   SPACE         U   737
***   SQ            U   723,723
 787  SQRT          A   723,796
***   SQUARE        U   790,794,795,799,859
  94  SRAM          A   171,241,379,413,509,2664
 379 SRAMDIG       A  377
2944 SRAMSG        A  1315
 151 STACK         A  315,344
***  START         U  313,316,320,327,370,379,395,401,410,428,434,490,912,
                      944,1075,1318,1342,1475,1482,1489
***  STAT          U  1084
***  STATIC        U  379,380,413,487,551,557
***  STATISTICAL   U  1400
***  STATUS        U  205,227,640,982,1306,2343,2348,2428
 703 STCHAR        A  700
***  STICK         U  1140,1144
***  STILL         U  770
***  STOP          U  2623
***  STORE         U  498,502,512,522,526,573,578,580,703,722,741,871,995,
                      996,1007,1217,1849,2253,2603,2606,2616,2617,2618
                      2619,2645
1110 STOREND       A  1087,1090,1096,1101,1106
 106 STRAT         A  395,401
 949 STRT2         A  912,944
 127 STTIM         A
 126 STTIM3        A
***  SUB           U  875,2250
***  SUBTRACT      U  858,2487
***  SUM           U  218,373,722,774,862,1071,1071,1072,1072,1074,1953
***  SUMMING       U  372
***  SYSTEM        U  315
 152 SYSTK         A  315,346
***  T             U  912
 136 T1CNTRL       A  582,584,591,2429
 130 T1LSB         A  574
 129 T1MSB         A  573
***  T2            U  910,911,914,942,943,944,946,948
 204 T2CNT         A  883,954
 137 T2CNTRL       A  583,590,2430
 132 T2LSB         A  579,589
 131 T2MSB         A  578,588
 134 T3LSB         A  581
 133 T3MSB         A  580
***  TAB           U  732
***  TABLE         U  664,724,725,726,729,1006,1073,1134,1189,1190,1202,1207,
                      1217,2374,2481,2494,2499,2508,2516,2577,2591
***  TAKE          U  2560
 199 TEMPT1        A  925,987,988
 200 TEMPT2        A  954,993
 221 TEN           A  2618,2646,2679,2689,2693
2686 TENLP         A  2682,2690
***  TENS          U  761,2979,2981,2983,2985,2987,2989
 227 TEST          A  180,227,269,298,404,408,409,442,443,510,640,640,641,
                      663,864,881,906,911,914,926,938,943,946,950,982,1080
                      1084,1716,1773,1778,1934,2174,2653,2654,2959
 298  TESTNM          A  1872,1882
***   THE             U  180,180,612,788,790,795,1075,1216,2048,2334,2342
***   THEIR           U  2002
***   THEN            U  697,877
***   THERE           U  468
***   THIRD           U  2183,2195,2210
***   THIS            U  438
***   THOUSANDS       U  743
***   THRESHOLD       U  2525
***   TICK            U  573,578,580
***   TICKS           U  572,577
 138  TIMADDR         A  569,2427
 124  TIMCONT         A  582
***   TIME            U  290,307,478,484,501,502,542,1138,1398,1643,1686,1687,
                         1705,2484,2487,2496,2556,2560,2562,2602,2603,2973
2422  TIMER           A  178,179,204,272,274,300,301,332,332,522,526,569,570,
                         575,580,588,590,872,881,883,926,982,1134,1135,1189
                         1196,1207,2428,2429,2653,2654,2962,2963,2964,2965
 300  TIMER1          A  985,1793,1798,1886
 301  TIMER2          A  950,1803,1806,1891
***   TIMERS          U  582
***   TIMES           U  1203
2650  TIMEXT          A  2630
 569  TIMINI          A  475
 178  TIMR1           A  521,570,984,1889
 179  TIMR2           A  525,575,585,990,1894
2439  TIMSCON         A  2432
2426  TIMSUB          A  1032,2423
 667  TLOOP           A  672,674,693,721,731,776
 673  TLOOP1          A  669
 156  TMFLG1          A
 158  TMFLG2          A
 157  TMVAL1          A  1888,1916
 159  TMVAL2          A  1893,1919
 153  TNUM            A  1882,1903
***   TO              U  246,413,473,484,487,551,557,572,577,592,639,681,684,
                         687,689,726,732,734,735,748,756,769,776,906,1078
                         1215,1323,1347,1474,1481,1488,1588,1592,1596,1600,1604,
                         1608,1612,1616,1620,1624,1628,1630,1848,1875,2251
                         2330,2342,2351,2485,2485,2490,2491,2499,2508,2517,2615,2643
***   TOFALLING       U  938
1414  TOGDSP          A  1387
***   TOP             U  1077,1189,1207
***   TOTAL           U  632
***   TR2             U  603
2120  TR2FWD          A  2117
 237  TR2HIGH         A  604,909,939,965,2160
 238  TR2LOW          A  606,607,907,941,967,2162,2163,2467,2475
2109  TR3FWD          A  2106
***   TRANSFER        U  486
***   TRANSLATION    U  732,2374
***   TRAP           U  317,318
***   TRG            U  907,909,939,941,965,967
 160  TRG1           A  2124
 162  TRG2           A  2125
 161  TRG2FL         A
 164  TRG3           A  2126
 163  TRG3FL         A
***   TRIG           U  237,238
 304  TRIG2          A  2112
 303  TRIG3          A  2090,2100
***   TRIGGER        U  173,175,177,281,303,304,527,534,538,2185,2190,2967,2969,2970,2971
***   TRIGGER2       U  283,1994,2200,2205,2210
***   TRIGGER3       U  1987,2195
 173  TRIGR1         A  530,2122,2124,2137,2449,2471
 172  TRIGR1H        A
 175  TRIGR2         A  533,2120,2121,2125,2141
 174  TRIGR2H        A  603,2159,2461
 177  TRIGR3         A  537,2110,2111,2126,2144
 176  TRIGR3H        A  916,2441,2525
1479  TRYB           A  1473
1486  TRYD           A  1480
 139  TSTAT          A  2428
 180  TSTINF         A  509,1881,1900,2123,2481,2556,2595
***   TURN           U  348,648,977,1036,1204,1305,1450,1457,1698,1718,1895,
                        2129,2176,2346,2656
***   TURNED         U  2296
1098  TWOSEC         A  1094
 222  UNIT           A  2619,2647,2680,2691,2694
2691  UNITLP         A  2687
***   UNITS          U  767,2978,2980,2982,2984,2986,2988
***   UP             U  215,430,634,793,985,1080,1082,1318,1342,1896
***   UPDATE         U  1006,1220,2047
***   UPPER          U  696,1143
***   USEC           U  979,1192,1699,1896,2130
***   USER           U  1381
***   VAL            U  234,305,682,2507,2519,2963,2965,2969,2971,2973,2974,2975
***   VALID          U  206,207,2446,2613
***   VALS           U  498
***   VALUE          U  182,183,184,195,201,218,220,286,522,526,539,542,545,
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                        2536,2568,2579,2592,2650,2972,2976
***   VALUES         U  486,1216,1404
 100  VARSTR         A  410,2663
 206  VBOOM          A  554,2610,2612,2613,2614
***   VECTOR         U  327,328,329,330,331,332,333
***   W              U  172,173,174,175,176,177,178,179,180,182,183,184,196,
                        198,205,206,207,210,215,216,217,219,223,228,230,231
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 ***  WAIT              U 663,693,776
 ***  WAS               U 916,1430,1434,2441
 ***  WERE              U 468
 ***  WITH              U 897,1201,1687,2047
 ***  WITHIN            U 876
 ***  WORD              U 247,373,400,405
 ***  WORDS             U 1135,1474,1481,1488
2341  WRDISP            A 1323,1347,2333
 123  WRITE             A 383,387,398,400,484,1164,1323,1347,1588,1592,1596,
                          1600,1604,1608,1612,1616,1620,1624,1628,1630,2333
1159  WRITEC            A 1141,1145
1126  WRTCLK            A 472,484,1701
1138  WRTCLK1           A 1146
 ***  XING              U 949
 292  YEAR              A 184,257,292,483,547,1587,1591,1655,1686,2976,2988
 190  YEAR1             A 483,1221,1231,1687
 ***  YEARS             U 190
 ***  YES               U 469,671,771,852,865,869,917,966,968,1016,1385,1717,1935,
                          2175,2526,2535,2623
 169  YMTIM             A
 ***  ZERO              U 372,391,405,439,462,466,736,1152,1476,1483,1490,1577,2650
 ***  _                 U 966
 ***  dB                U 2225,2230
 ***  mSEC              U 2235,2238
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4. BEAR HARDWARE DESCRIPTION

4.1 Overview

The Boom Event Analyzer Recorder (BEAR) is a software controlled instrument that digitizes the sound pressure level present at the BEAR' microphone and analyzes these data using programmable parameters to determine if the signal was a sonic boom. The date of an event is retained in the removable battery RAM modules that can be later processed for further analyses. The software was written in 68000 assembler language. The devices that are being controlled are:

- 16 bit A/D converter being sampled at 8 khz.
- Key pad for parameter entry.
- Alphanumeric display for parameter display and error messages.
- Real-time clock for time and date information.
- Two programmable timers for defining event windows.

4.2 Parts List

ENCLOSURE CASE

August 16, 1989

Designator	Part No., Description, Manufacturer	Quantity
Zero Case	105x, Zero, Halliburton Corp	1
Zero Panel Brackets	ZP 20653 (two modified in house) Zero,Halliburton Corp	7
Connectors	EGG2B303CNL Lemo Connector	3
Connector Dust Caps	RA 2295 Lemo Caps	3
Isolated BNC	31-10, Amphenol	1
BNC Cover	31-6, Amphenol	1

BEAR MODEL 1020 FRONT PANEL

August 16,1989

Designator	Part No., Description, Manufacturer	Quantity
Adjustable Grip Latch	27-10-311-20, Southco Inc.	1
Push Button Switch	MSPF-101C, Alco	1
Toggle Switch	MTF1060, Alco	1
Analog Meter	50-281011 NDND, General Electric	1
Key Pad	PTS1-51224-P630, IEE, Industrial Electronic Engineer	1
Front Panel	MFG - See Drawing SRL "Front Panel"	1
Battery Case	MFG - See Drawing SRL "Battery Case"	1

BEAR MODEL 1020 DATA ACQUISITION BOARD

August 16, 1989

Designator	Part No., Description, Manufacturer	Quantity
C1,3,5,7,9,11, C13,15,17,19, 23,25,27,29,32, 34,35,37,39,41, 45,47,49,51	C320C104K5R5CA, .1uf 50 WVDC X7R Ceramic Capacitor, Kemet	24
C2,4,6,10,12, 14,16,18,20,22, 24,26,28,30,33, 36,38,40,42,46, 48,50,52,54	T350E106K025AS, 10uf 25 WVDC Tantalum Capacitor, Kemet	24
C8	X363UW, 15uf 100 WVDC Polypropylene Capacitor, TRW (American Shizuki)	1
C31	C330C103K1G5CA, NPO 10% 100 WVDC .01uF Ceramic Cap, Kemet	1
C21,53	203A14 .02uF 14 Pin Decoupling Caps for U6 and U10, Rogers	2
C43,44	C315C102K1G5CA, NPO 10% 100 WVDC .001uF Ceramic Capacitor, Kemet	2
CR1 thru CR4	1N5819, Schottky Barrier Diode, Motorola	4
R1	RN55E2491F, 2.49K ohm 1/8w 1% 25 ppm Metal Film Resistor	1
R2	RN55E2212F, 22.1K ohm 1/8w 1% 25 ppm Metal Film Resistor	1
R4	3266W-1-103, 10K ohm Potentiometer, Bourns	1
R3,R5	RN55D1000F, 100 ohm 1/8w 1% 100 ppm Metal Film Resistor	2
R6	RN55E1542F, 15.4K ohm 1/8w 1% 25 ppm Metal Film Resistor	1

BEAR MODEL 1020 DATA ACQUISITION BOARD
(continued)

Designator	Part No., Description, Manufacturer	Quantity
R7	3266W-1-102, 1K ohm Potentiometer, Bourns	1
R8	3266W-1-203, 20K ohm Potemtiometer, Bourns	1
R17,R20	RN55D10R0F, 10 ohm 1/8 w 1% 100 ppm Metal Film Resistor	2
R19	RN55D7152F, 71.5K 1/8 w 1% 100 ppm Metal Film Resistor	1
R18	RN551D1242F, 12.4K 1/8 w 1% 100 ppm Metal Film Resistor	1
R9,R11	RN55E2211B, 2.21K 1/8w .1% 25 ppm Metal Film Resistor	2
R10,R12	RN55E1821B, 1.82K 1/8w .1% 25 ppm Metal Film Resistor	2
R14	RN55D1001F 1.0K 1/8w 1% 100 ppm Metal Film Resistor	1
R13	RN55D4702F, 47K 1/8w 1% 100 ppm Metal Film Resistor	1
R15	RN55D22R1F, 22.1 ohm 1/8w 1% 100 ppm Metal Film Resistor	1
R16	RN55D05R0F, 5 ohm 1/8 w 1% 100 ppm Metal Film Resistor	1
J5	609-2634E, 26 Pin Ribbon Cable Header, Ansley Connector (26 pin cable fabricated in house)	1
J1	Straight Square 4 Pin Friction Lock Header, 22-11-2042, Molex 6373 Series	1
J2	4578, BNC Female PC Mount, Pomona	1
Jmp 1-4	TSW-103-08-GS, 3 Pin Jumper Stakes, SAMTEC	4
Shunt Plugs	CA-02-SJC-B, 2 Pin Jumper Plugs, SAMTEC	4

BEAR MODEL 1020 DATA ACQUISITION BOARD
(continued)

Designator	Part No., Description, Manufacturer	Quantity
U2	AD584LH, Voltage Reference, Analog Devices	1
U4	678-2K0, Anti-Aliasing Filter, Frequency Devices	1
U9	CS5016-JC16, 16 Bit Analog to Digital Convertor, Crystal Semiconductor	1
U1,U3	OPA 111 BM, Op Amp, Burr-Brown	2
U11	RC4194TK, Dual Tracking Regulator TO-66, Raytheon	1
U5,U8	OPA27EZ, Op Amp, Burr Brown	2
U7	REF10KM, Precision 10 Volt Reference, Burr-Brown	1
U10	74HC04N, High Speed CMOS Hex Inverter	1
U6	74HC74N, High Speed CMOS Dual Flip Flop	1
S1	840AG11D, 40 pin Gold Plated Contact Socket for U9, Augat	1
P1	4 pin Polarized Housing with locking Ramp, 22-01-3047 (cable fabricated in house), Molex, 2695 Series	1
P2	31-335, Crimp Right Angle BNC Male Plug (cable fabricated in house), Amphenol	1
	08-50-0114 Molex 2759 Series Crimp Terminals	4
	Model 1020 A/D MultiLayer P.C.B.	1

BEAR MODEL 1020 MOTHER BOARD

August 16, 1989

Designator	Part No., Description, Manufacturer	Quantity
	Circuit Board	1
R1,R2	Not Used	
R3,R4,R19-R21	RCR07G332JS, 3.3K ohm 1/4 w 5% carbon, Allen Bradley	5
R5,R12	RCR07G471JS, 470 ohm 1/4 w 5% carbon, Allen Bradley	2
R6,R7,R9,R24	RCR07G103JS, 10K ohm 1/4 w 5% carbon, Allen Bradley	4
R8,R14,R16-R18	RCR07G102JS, 1K ohm 1/4 w 5% carbon, Allen Bradley	5
R10,R11	RCR07G105JS, 1 Meg ohm 1/4 w 5% carbon, Allen Bradley	2
R13,R15,R22,R23	RCR07G472JS, 4.7K ohm 1/4 w 5% carbon, Allen Bradley	4
R25	5063JD154K0F, 154K ohm, 1/8 w 1% 150 ppm Metal Film Resistor, Mepco Electra	1
R26	5063JD20K00F, 20K ohm, 1/8 w 1% 150 ppm Metal Film Resistor, Mepco Electra	1
R27	5063JD5M110F, 5.11 Meg, 1/8 w 1% 150 ppm Metal Film Resistor, Mepco Electra	1
C1-C3,C6,C19, C22-C33,C36, C39-C40	1C1025U104M050B, .1uF 50WVDC Ceramic Capacitor, Sprague	19
C4,C5	Not Used	
C7-C14,C17,C18	T350G156K025AS, 15uF 25WVDC, Tantalum Kemet	10
C34,C35,C38	T350E106K025AS, 10uF 25WVDC Tantalum, Kemet	3
C37,C41	T350A105K025AS, 1uF 25WVDC Tantalum, Kemet	2
C15,C16,C20,C21	Not Used	

BEAR MODEL 1020 MOTHER BOARD
(continued)

Designator	Part No., Description, Manufacturer	Quantity
Q1,Q2	Not Used	
Q3,Q4	VN0104N3, Power MosFet, General Electric	2
CR1,CR2	Not Used	
VR1-VR4	LM7805, +5 volt regulator, Motorola	4
VR5	Not Used	
HS1-HS4	THM62073, Heat Sink, Thermalloy	4
HS5	Not Used	
Y1	XO-53B, 16.0 Mega Hertz, Dale	1
RP1,RP2	CSC-08-103G, 10K ohm Resistor Pack, Dale	2
J1	Molex, 4 pin receptacle, 22-11-2042	1
P2	15-31-1026, Connector, Molex	1
P3	25-0517-90C, Pin Line Collet, Airies or SS-132-G-2 Socket Strip Samtech	1
P4	3802-08-016, LCD, IEE, Industrial Electronic Engineer	1
P5	609-2634E, Connector, Ansley	1
U1-U3,U29	MC74HC4017N, Motorola	4
U4,U22,U42	MC74HC08N, Motorola	3
U5	Not Used	
U17,U18	MC74HC245N, Motorola	2
U6,U14	HM1-65162-9, 2Kx8 static RAM, Harris	2
U7,U8,U15,U16	HN27C64G-15, Hitachi	4
U9,U10	32Kx8 Memory SIP, SRL	2
U11	966, DC/DC Convertor, Analog Devices	1

BEAR MODEL 1020 MOTHER BOARD
(continued)

Designator	Part No., Description, Manufacturer	Quantity
U12,U13	100-096-153, 96 Pin Connector, Panduit	2
U19	MC68HC000P8, CMOS Microprocessor, Motorola	1
U20	MC74HC27N, Motorola	1
U21	MC74HC00N, Motorola	1
U23,U24,U33	MC74HC32N, Motorola	3
U25	MC74HC139N, Motorola	1
U26,U27	MC74HC138N, Motorola	2
U28,U39	MC74HC373N, Motorola	2
U32,U35,U50	74HC04N, Motorola	3
U51	ICL8211CPA, Voltage Detector, Intersil	1
U30	LM555N, National	1
U31	MC74HC20N, Motorola	1
U34	MC74HC02N, Motorola	1
U36	Not Used	
U37	MC74HC147N, Motorola	1
U38	MM74C906N, National	1
U40	MC6340P, Motorola	1
U41,U43	MC74HC03N, Motorola	2
U44	MC74HC175N, Motorola	1
U45,U46	MC74HC74N, Motorola	2
U47	MM74C923N, National	1
U48	MC6821P, Motorola	1
U49	RTM3, Catalyst, Research Corp	1
Micro Q Capacitor	u14.02, Rogers Corporation	17

BEAR MODEL 1020 MOTHER BOARD
(continued)

Designator	Part No., Description, Manufacturer	Quantity
Micro Q Capacitor	u16.03, Rogers Corporation	5
Micro Q Capacitor	u20.03, Rogers Corporation	5
Micro Q Capacitor	u24.07, Rogers Corporation	2
Micro Q Capacitor	u28.07, Rogers Corporation	5
Augat Socket	564-AG12D	1
Augat Socket	528-AG12D	5
Augat Socket	524-AG12D	2
Augat Socket	540-AG12D	1

BEAR MODEL 1020 MEMORY MODULES

August 16, 1989

Designator	Part No., Description, Manufacturer	Quantity
	Circuit Board	3
J1	4-102887 Right Angle Header Amp (36 pin)	1
RP1	CSC10A-01-103G, 10 Pin SIP 9-10K Resistors, Dale	1
U1-U4	SRM 20256 C10 256K Bit Static Ram SMOS Systems	4
U5	74HC138, 1:8 Demux, Motorola	1
B1	B1000 2.8V Lithium Iodine Battery Catalyst Research	1
J1	100-96-459, 96 pin Wire Wrap Connector Panduit	1
R1	RCR07C472JS, 4.7K 1/4W 5% Resistor Allen Bradley	1
U1	DRM2, Memory Module Catalyst Research	1
Zero Box	Z48-80A-2.40BB, Rectangular Box w/ Nut Plates, Zero Halliburton Corp	1
Cover	Cover 1/16 x 3" x 5" Jade Tool	1
Micro Q Capacitor	u14.02, Rogers Corporation	1
Micro Q Capacitor	u28.07, Rogers Corporation	4

BEAR MODEL 1020 MISCELLANEOUS HARDWARE

August 16, 1989

Designator	Part No., Description, Manufacturer	Quantity
2-56 x 1/4"	Flat Head Screws Slotted (Keyboard Mount)	4
2-56 x 3/8"	Nylon Roundhead Screws Slotted (LCD Mount)	4
2-56 x 3/16"	Nylon Space RS (LCD Mount) P/N 4000 HH Smith	4
2-56	Nylon Nuts (LCD Mount)	4
4-40 x 1/2"	Round Head (Memory Module)	2
4-40 x 1/2"	Flat Head Screws Slotted (A/D Panel)	4
4-40 x 1/4"	Pan Head Screws Slotted (A/D Panel) (Heat Sinks)(Memory Module)	16
4-40 x 1/4"	Threaded Standoff Nylon (Memory Module) P/N 4050, H H Smith	4
4-40 x 1"	Threaded Standoff (A/D Panel) (P/N 46F2317)	4
4-40	Hex Nut (Heat Sinks, Memory Module)	6
4-40	Lock Washer (Heat Sinks)	4
8-32 x 1/2"	Pan Head (Memory Module)	4
6-32 x 3/4"	Flat Head Screws Phillips (Mother Board (Mount)	15
6-32 x 5/16"	Nylon Spacers (Mother Board Mount)(P/N 4010) HH Smith	15
6-32	Nylon Nuts (Mother Board Mount)	15
10-32 x 1/2"	Oval Head Screws Slotted Front Panel Mount	5
33F1362	Female Nylon Insulated Disconnect (small battery) (22-18 gauge)	6
31N558	Ring Terminal (large battery) (16-14 gauge 1/4" stud size)	6
1/4" x 20 x 3/4"	Hex Head Bolt (large battery)	6
1/4" x 20	Hex Nut (large battery)	6

BEAR MODEL 1020 MISCELLANEOUS HARDWARE
(continued)

Designator	Part No., Description, Manufacturer	Quantity
1/4"	Lock Washer (Internal Star) (large battery)	6
34142	Ring Terminal (22-16 gauge) (meter leads)	2

MODEL 1020 MISCELLANEOUS OTHER

August 16,1989

Designator	Part No., Description, Manufacturer	Quantity
10" Microdot BNC Cable	002B00.10, PCB	1
Microphone	106B50, PCB	1
25' Coax Cable	RG58 wire, (Fabricated in house)	1
BNC Connector	(for coax cable) PN 5285, Crimp BNC Male Cable Plug, Pomona	2
10" Ribbon Cable	26 pin ribbon cable w/connectors Ansley flat cable p/n 201-26	1
26 Pin Conn.	Ansley Connector p/n 609-2641	2
2 wire 16 awg	5432 (Alpha)	-
18 awg (red) wire	A1833-3 (Alpha)	-
16 awg (black) wire	A1834 (Alpha)	-
4 awg Glass Sleeving	P1F200-4	-
Shrinkable Tubing (Black)	FIT221-1/4 (Alpha)	-
Shrinkable Tubing (Red)	FIT221-1/4 (Alpha)	-
Shrinkable Tubing (Black)	FIT221-1/2 (Alpha)	-
Shrinkable Tubing (Black)	FIT221-1/8 (Alpha)	-
2 wire 18 awg	9708 (Beldon) Clear Wire (small battery)	-
Hinge	1581A39 Blank Aluminum Continuous Hinge McMaster Carr (For A/D Door on Front Panel)	-
Power Sonic Battery	PS 1265, 6.5 Amp (Small Battery)	3

MODEL 1020 MISCELLANEOUS OTHER
(continued)

Designator	Part No., Description, Manufacturer	Quantity
Johnson Control Battery	GC 12800-1B, 12 Amp (Large Battery)	3
Molex Connector	19-09-2029 Male Plug	3
Molex Connector	19-09-1029 Female Receptacle	4
Molex Terminal Pins	02-09-1104 Female	6
Molex Terminal Pins	02-09-2103 Male	8
Lemo Connector	FGG2B303CNAD99 Straight Plug 3 pin Male	3
Molex Connector 4 PIn	22-01-2047 Series 2695	2
Molex Crimp Pins	08-50-0114 (Cable made in house)	8
Foam Rubber	2lb Density Charcoal Polyester 20" L x 3¼" W x 3" H Miami Valley Gasket	1
6-32 x 3/8"	Pan Head Slotted Screw	2
6-32	Metal Nut	2
#10	Flat Washers	2
#10	Lock Washers	2
8-32 x ¼"	Pan Head Slotted Screw	4

4.3 Drawings

The following are the electronic circuitry schematics for the BEAR systems. Full scale schematics are available from :

Systems Research Laboratories
2800 Indian Ripple Road
Dayton, Ohio 45440-3696

Telephone (513)426-6000

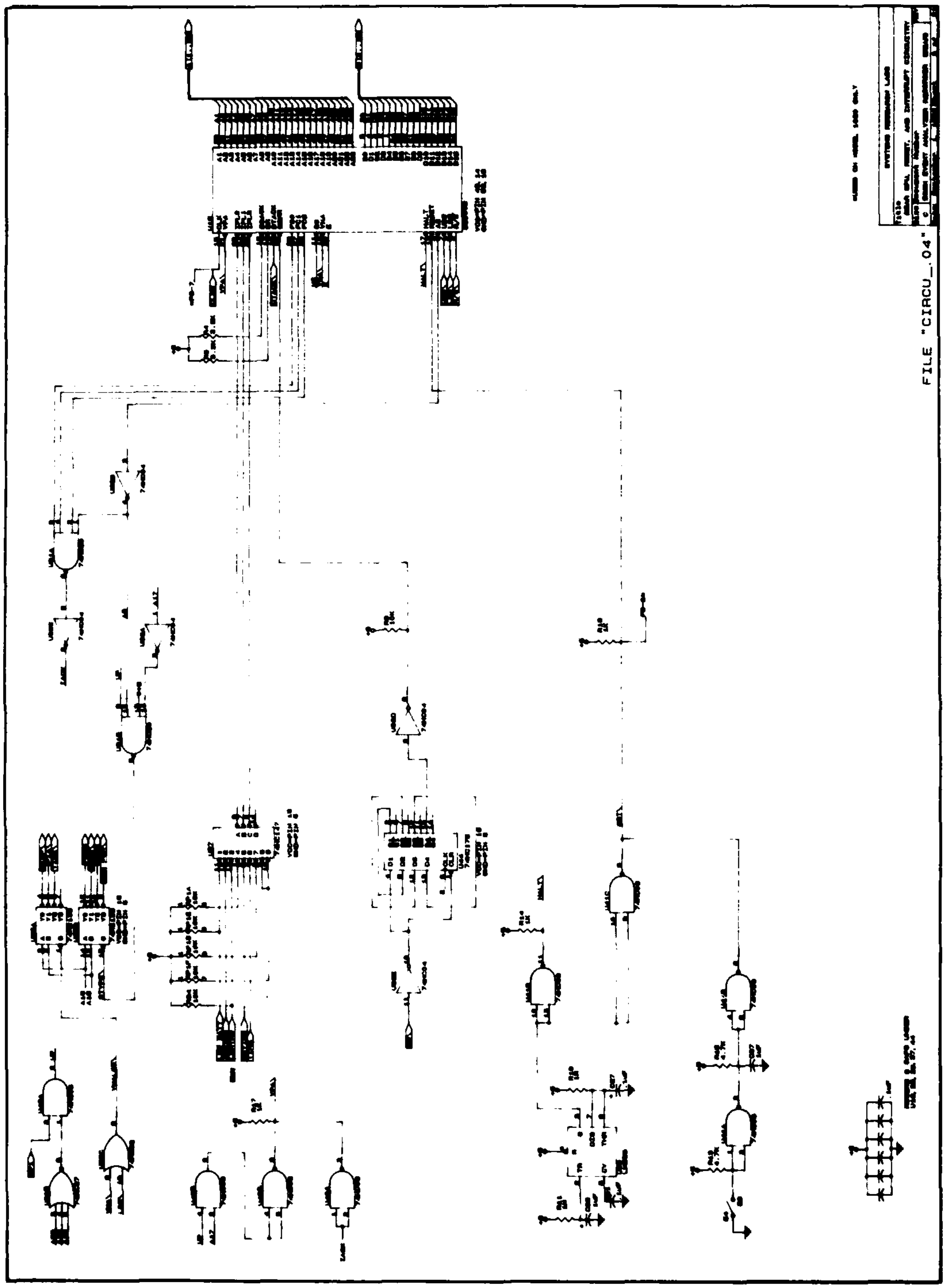

Figure 28. BEAR CPU, Reset and Interrupt Circuitry Diagram

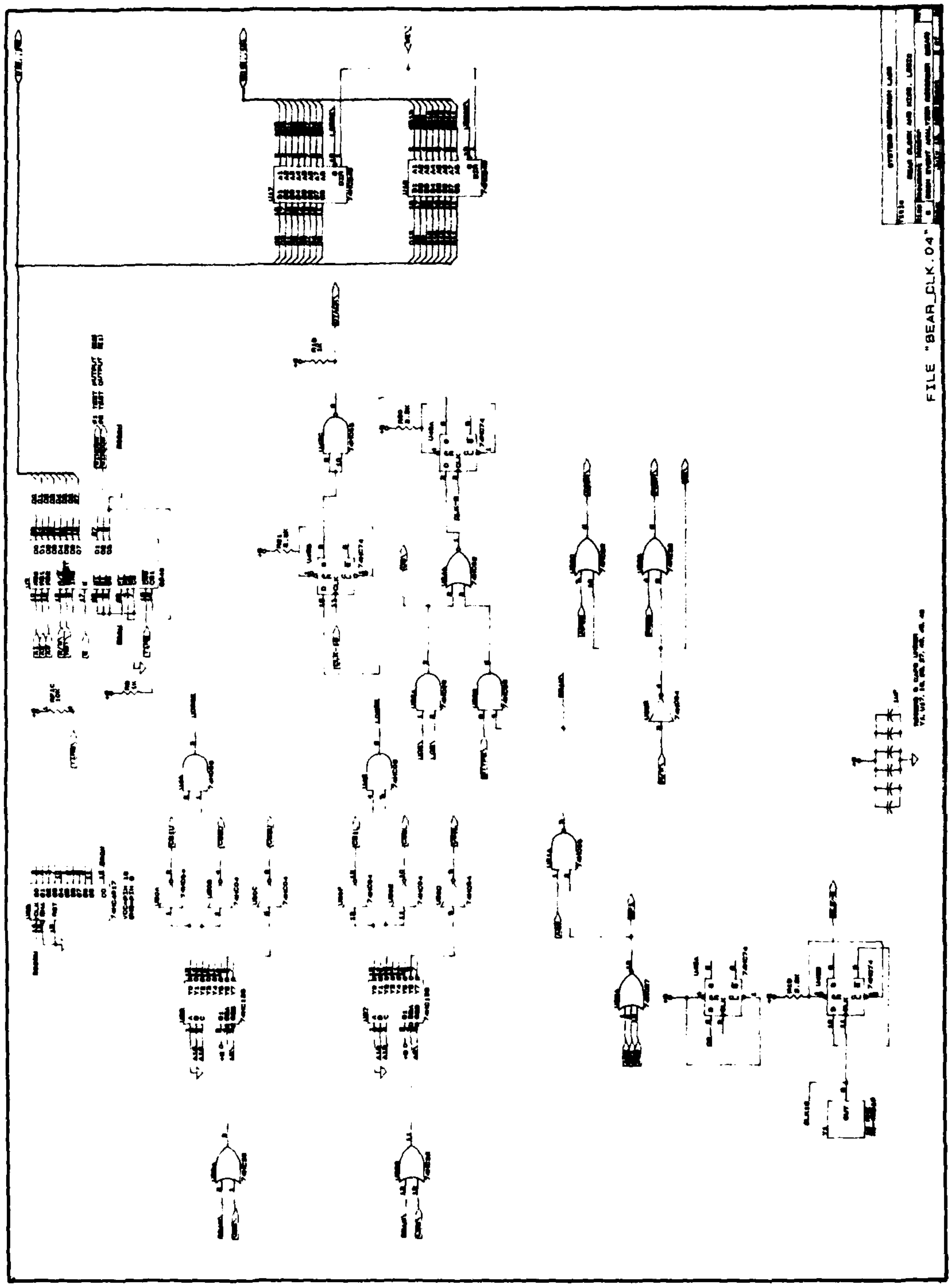

Figure 29.   BEAR Clock and Miscellaneous Logic Diagram

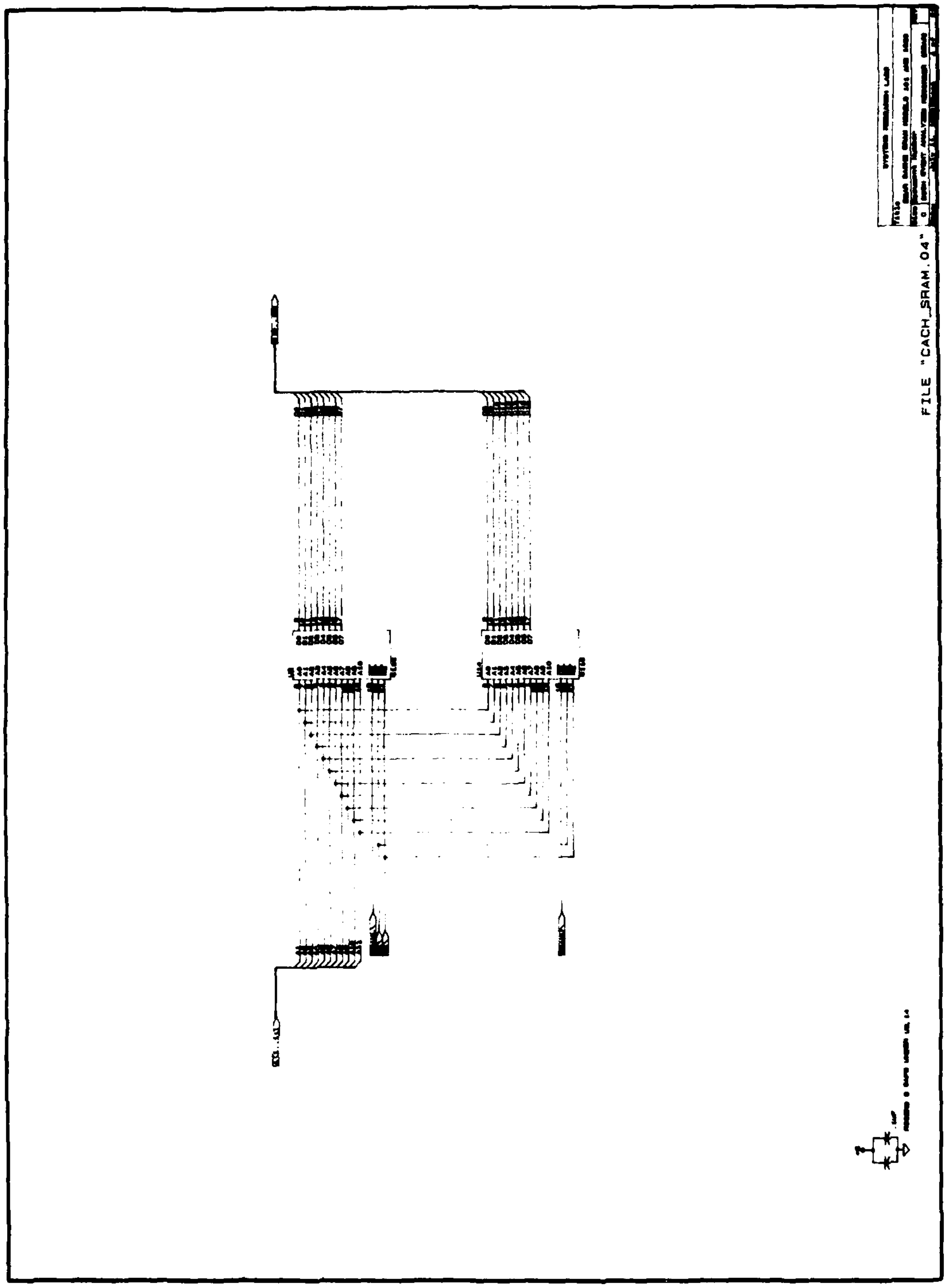

Figure 30. BEAR Cashe SRAM Diagram

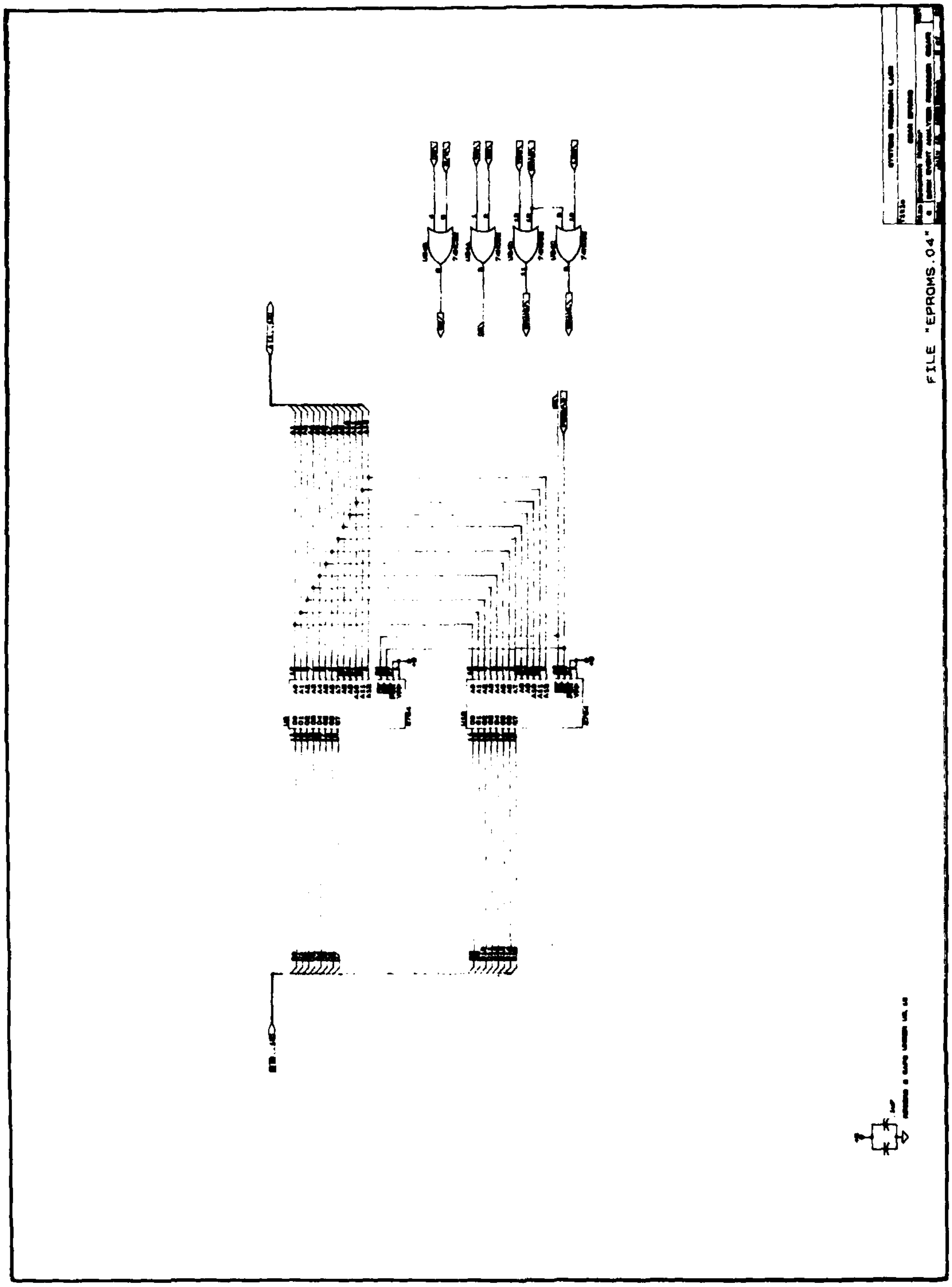

Figure 31. BEAR EPROM's 1 Diagram

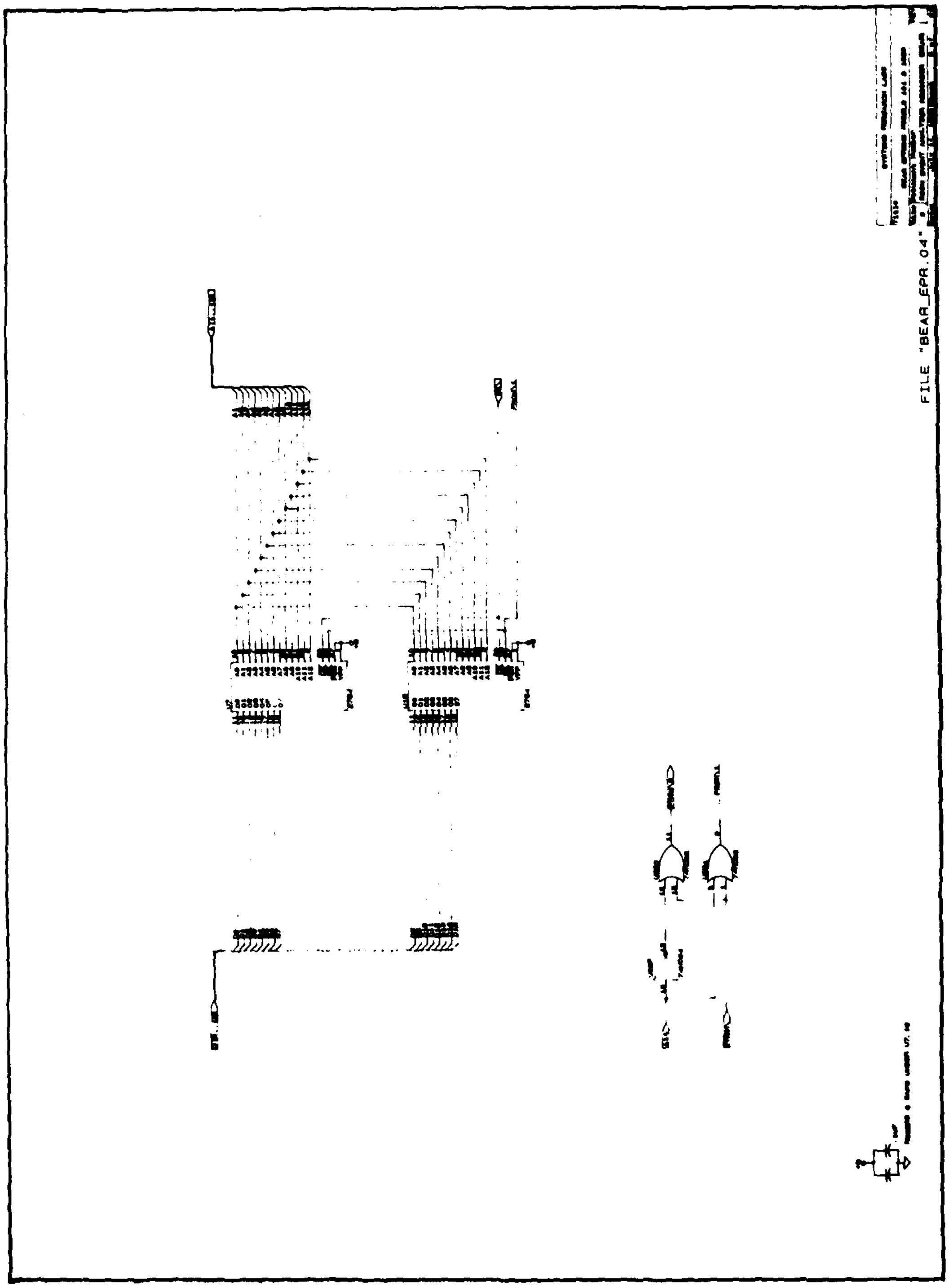

Figure 32. BEAR EPROM's 2 Diagram

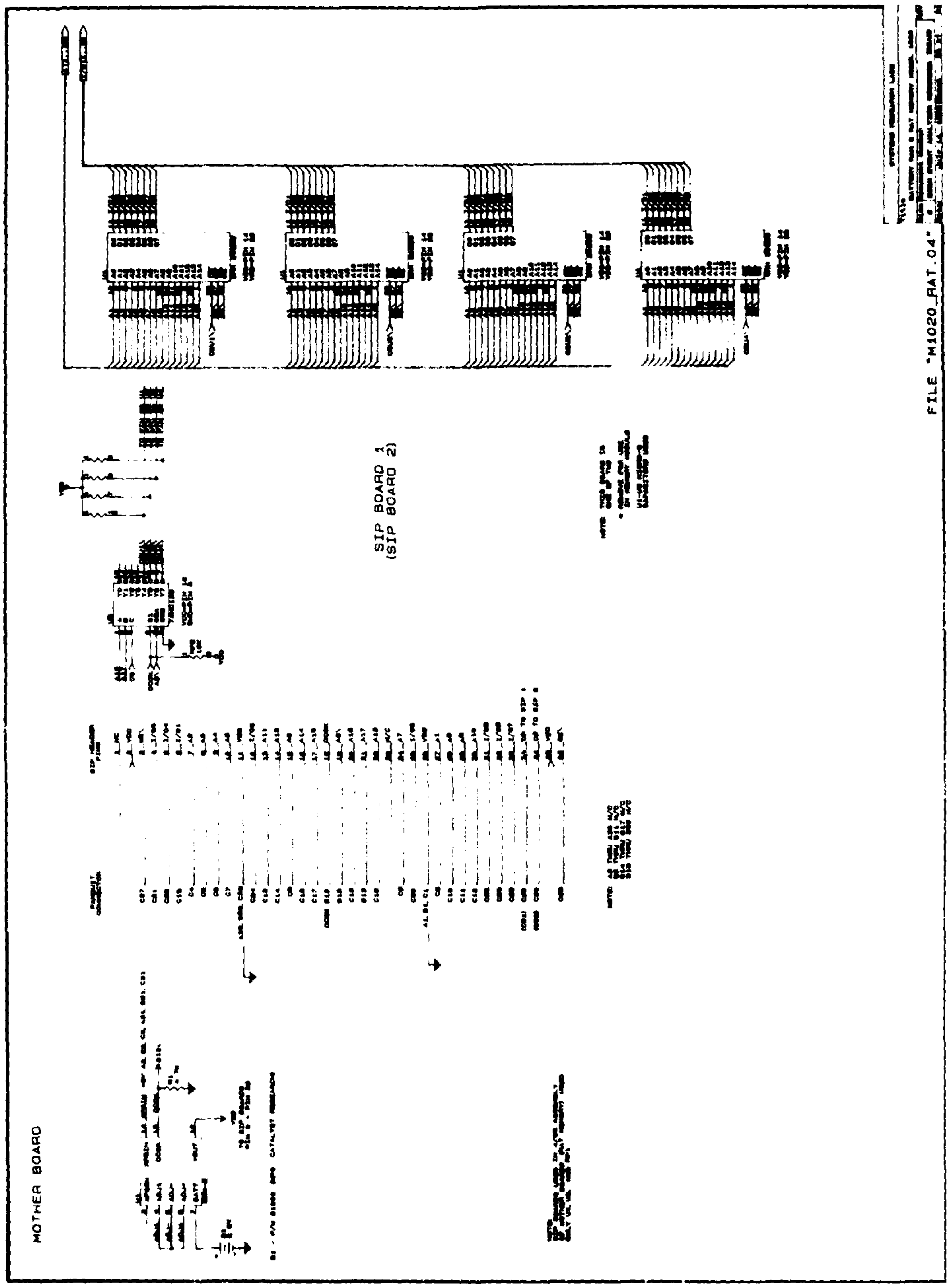

Figure 33. BEAR Battery RAM and RAT Memory Diagram

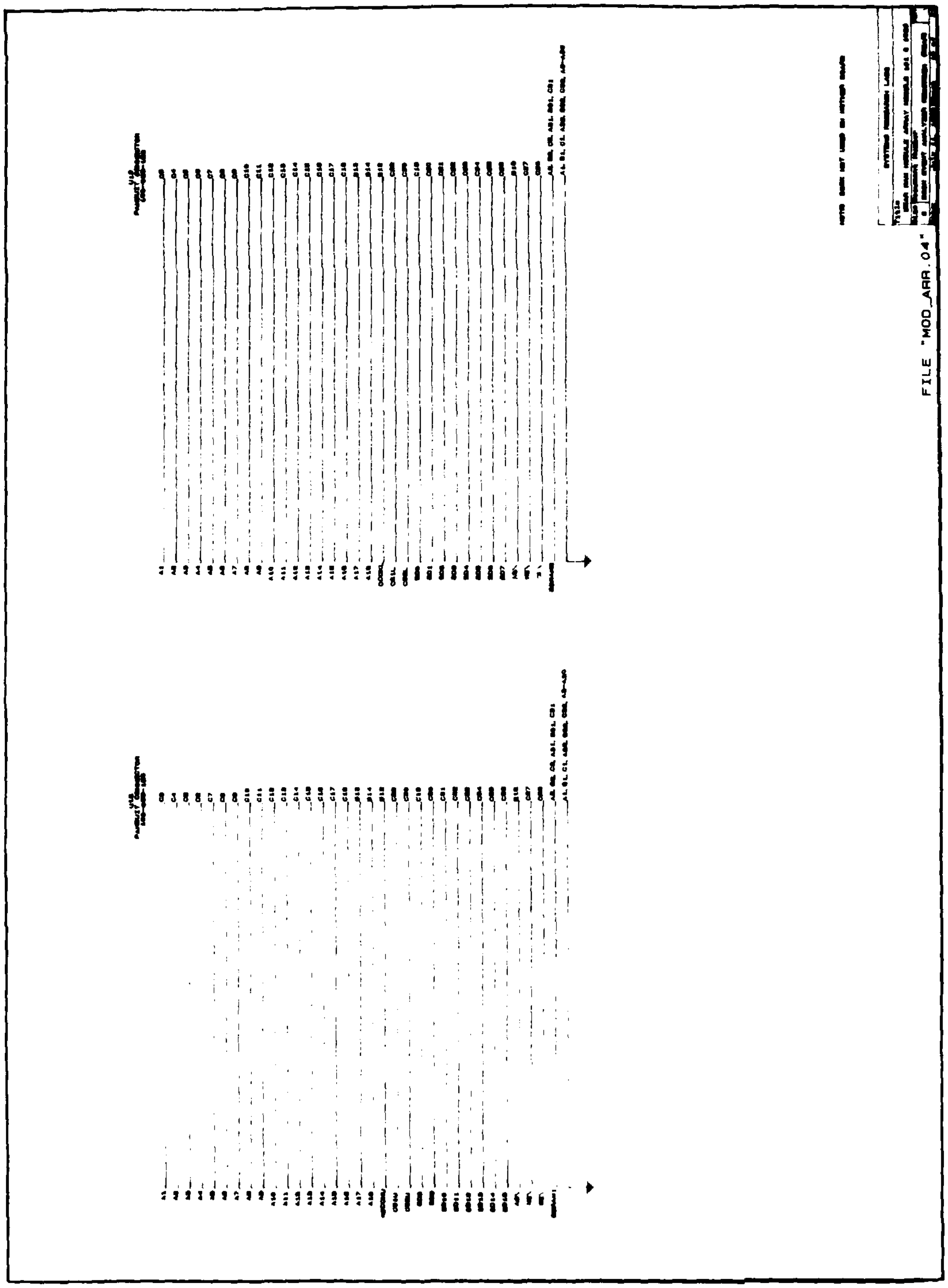

Figure 34. BEAR RAM Module Array Diagram

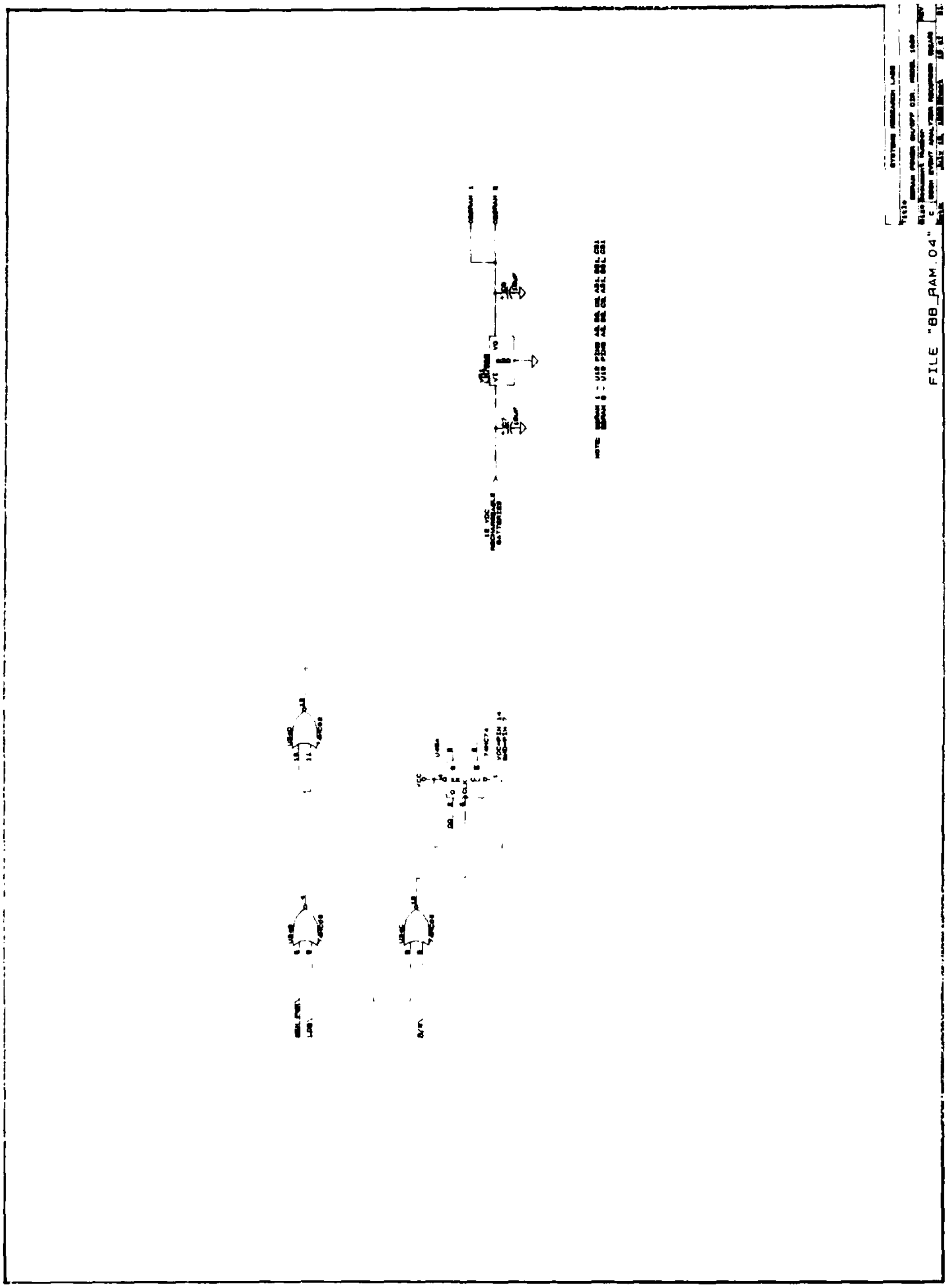

Figure 35. BEAR BBRAM Power On/Off Circuitry Diagram

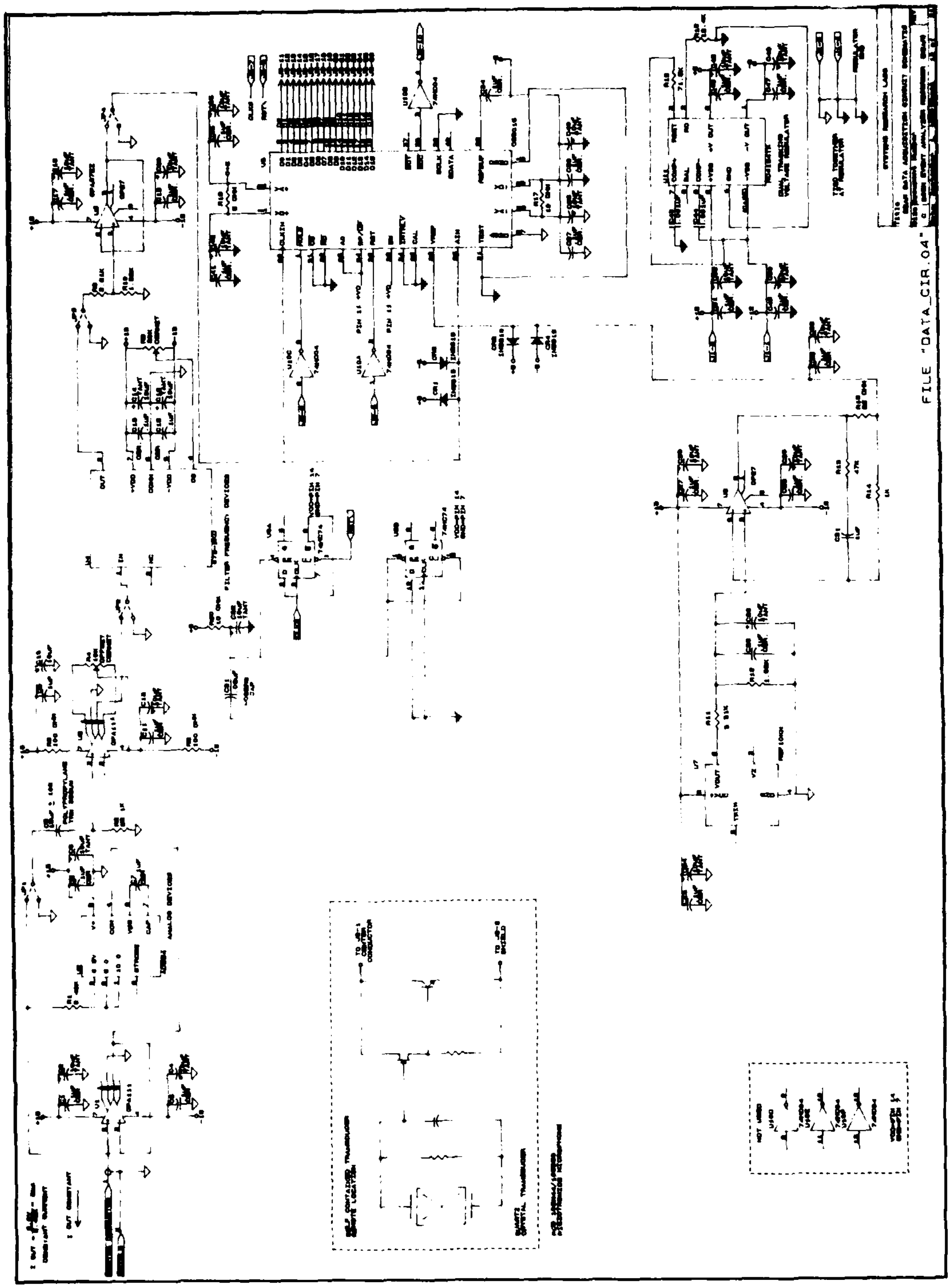

Figure 36. BEAR Data Acquisition Circuit Diagram

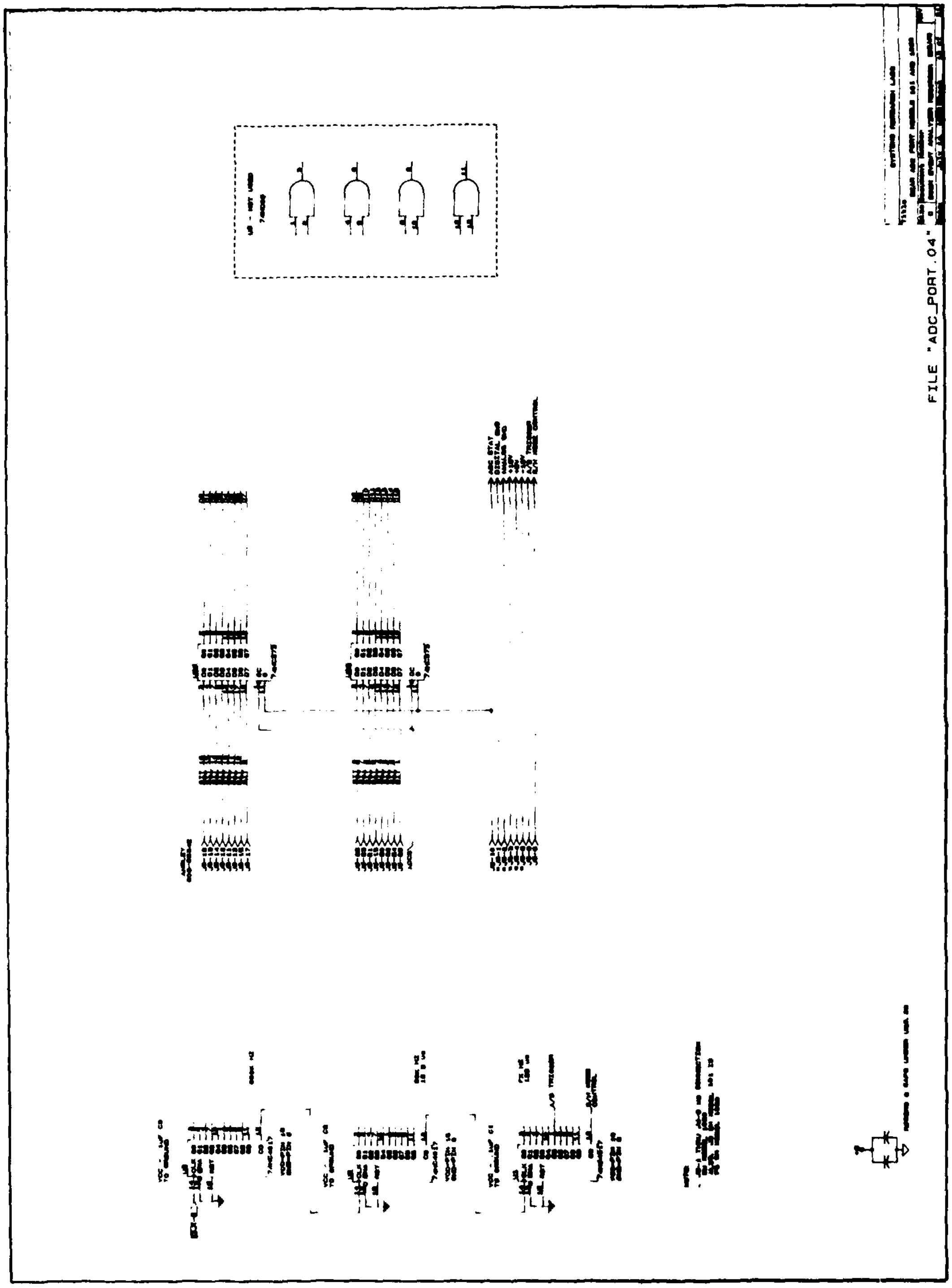

Figure 37. BEAR ADC Port Circuit Diagram

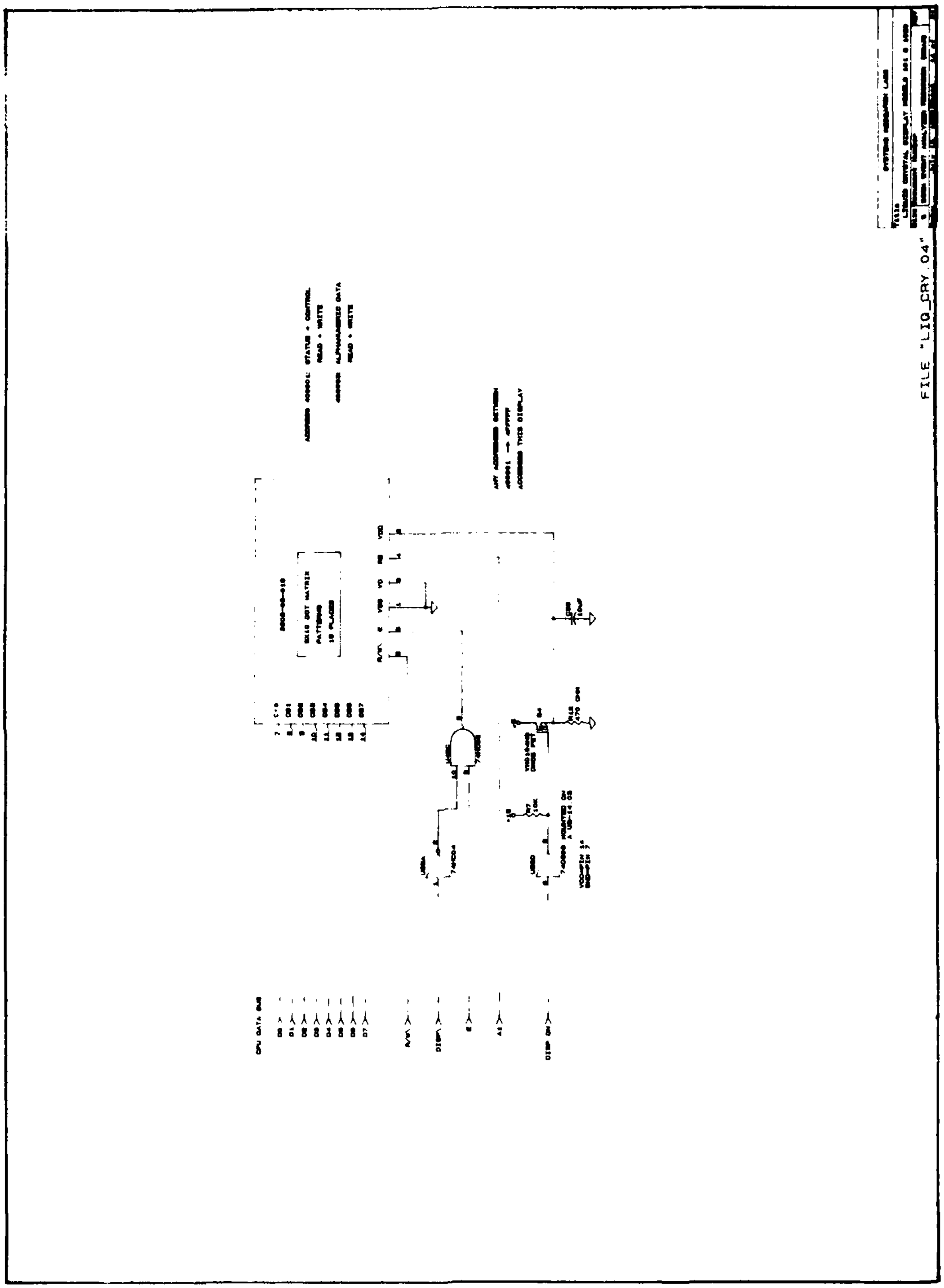

Figure 38. BEAR Liquid Crystal Display Circuit Diagram

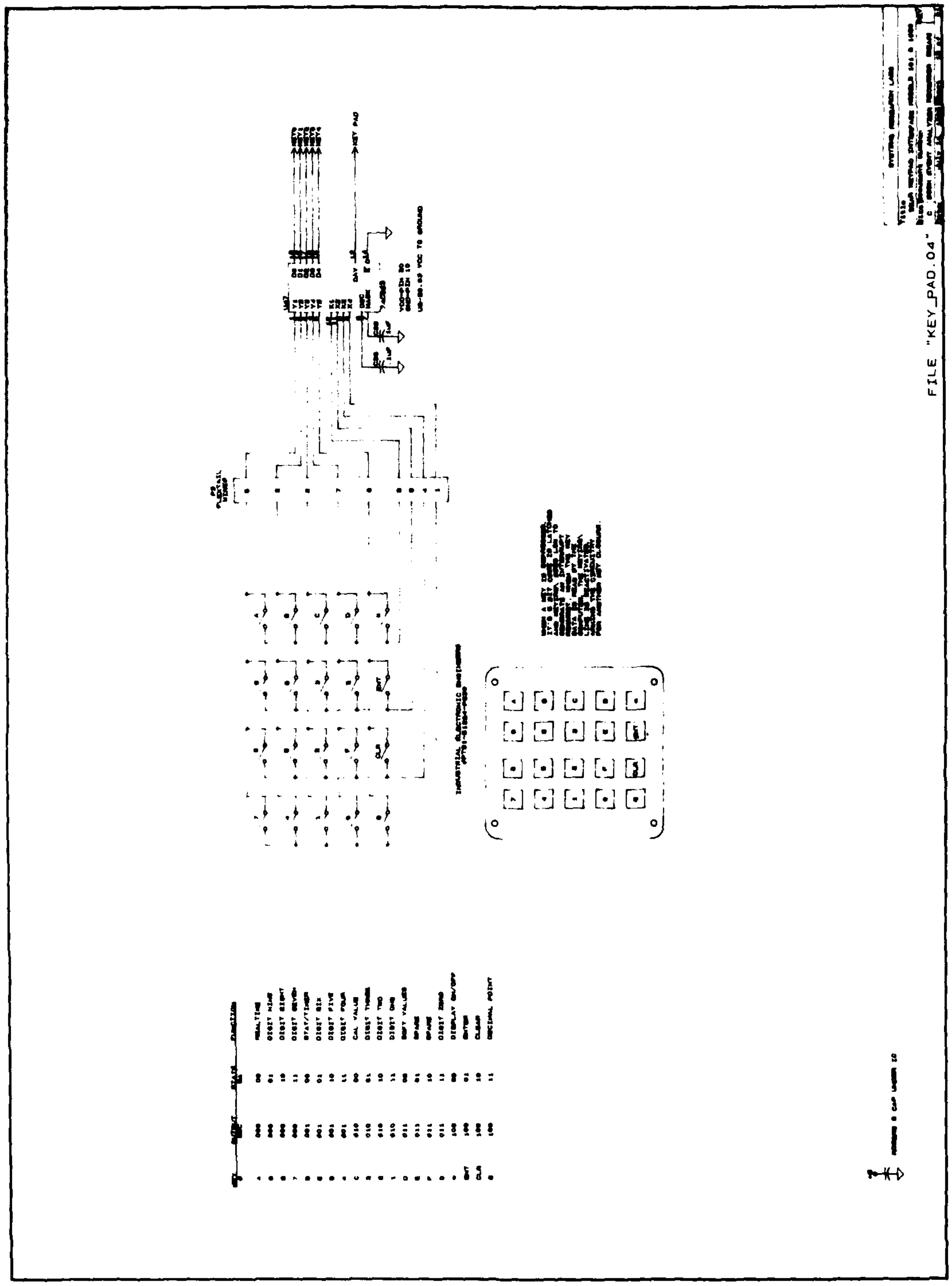

Figure 39. BEAR Keypad Interface Circuit Diagram

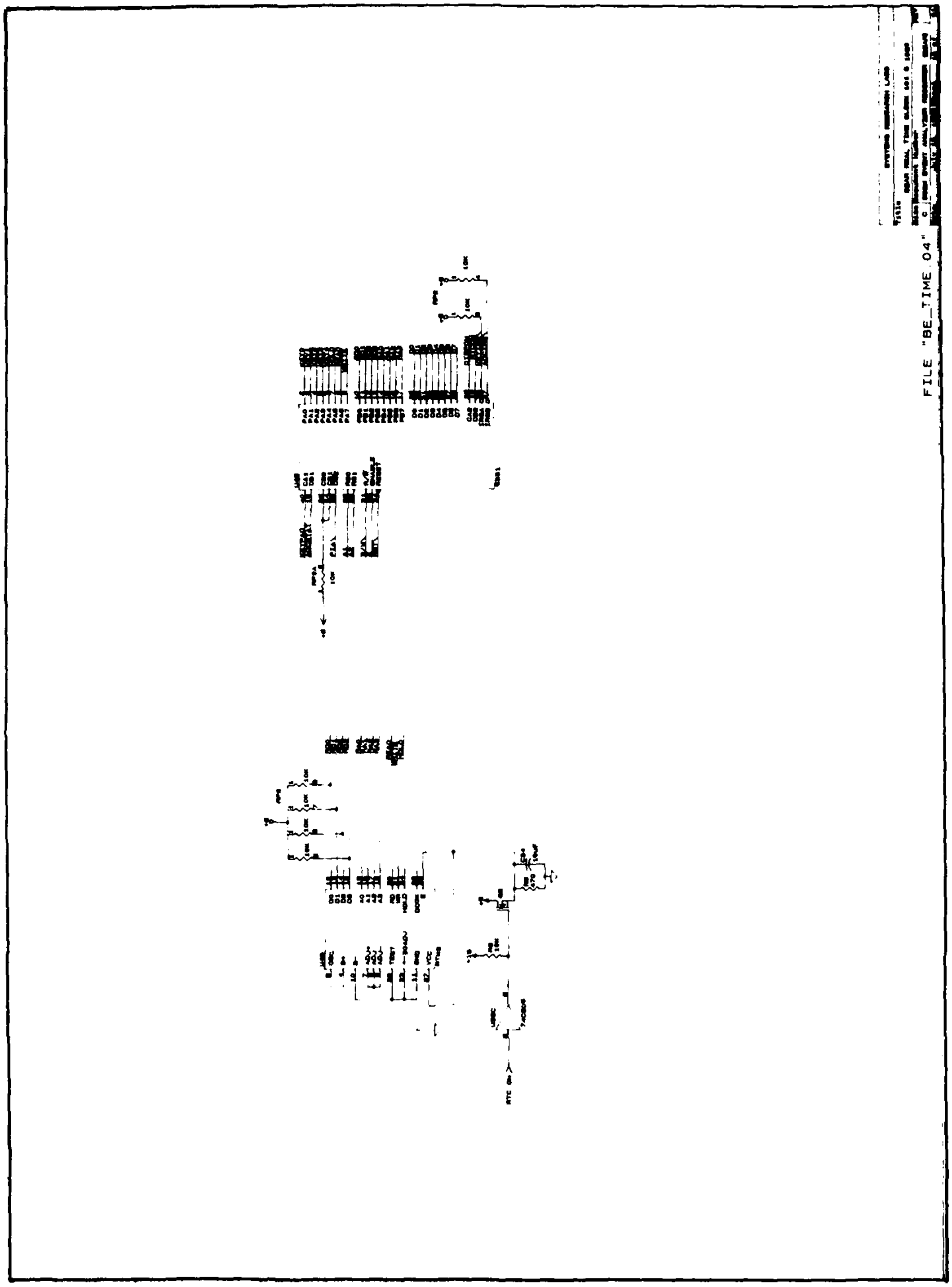

Figure 40. BEAR Real Time Clock Circuit Diagram

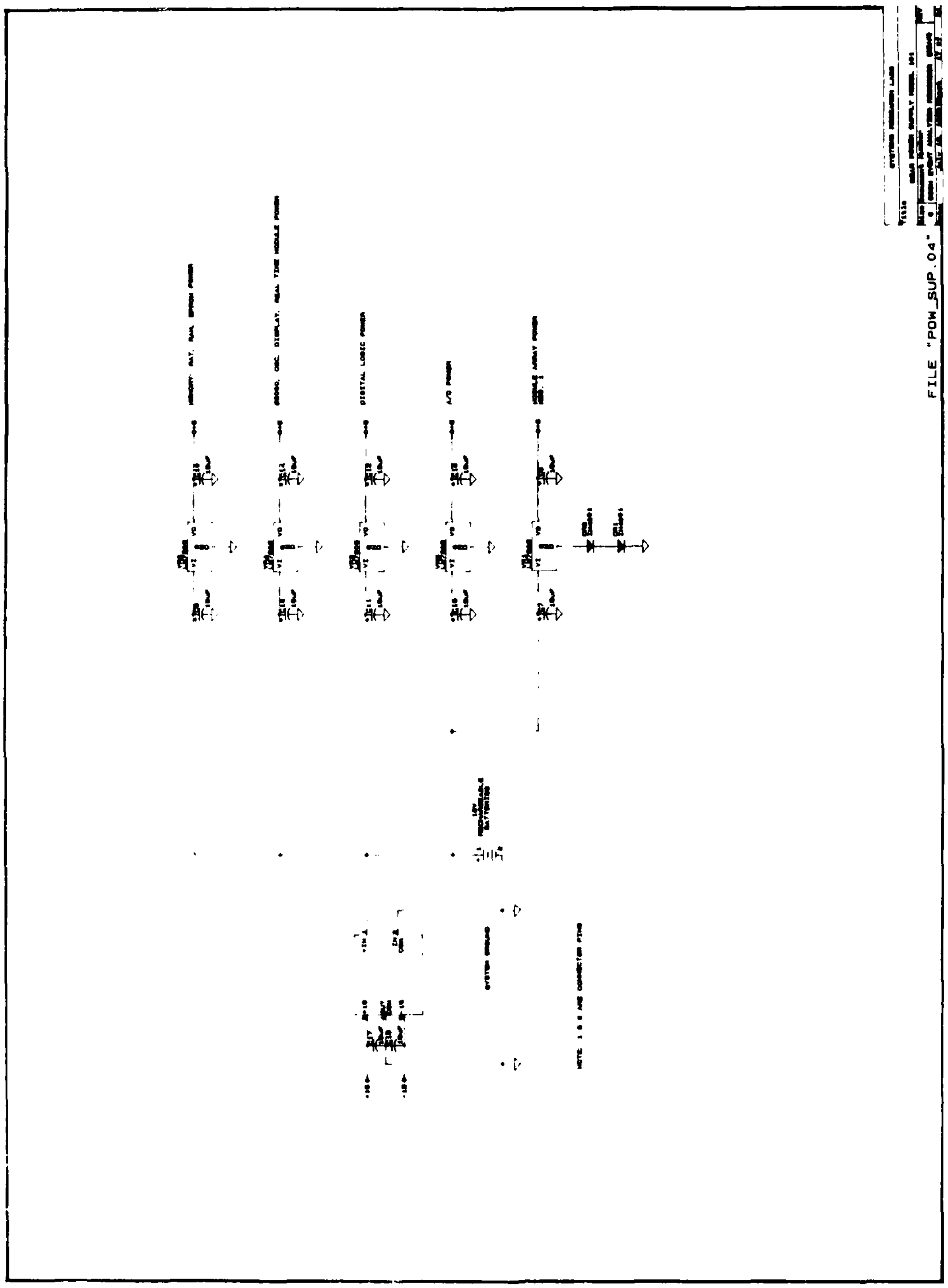

Figure 41. BEAR Power Supply Circuit Diagram

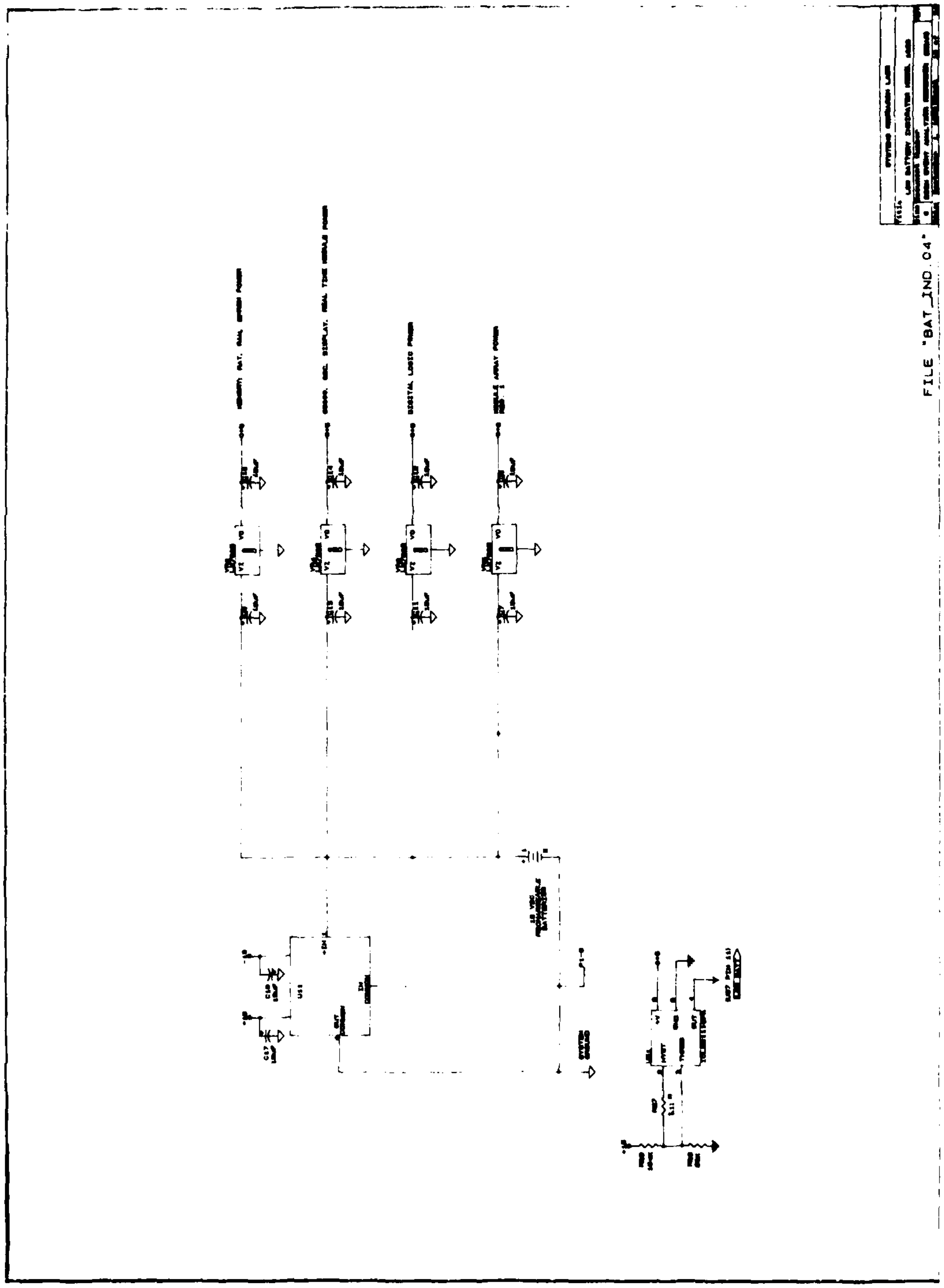

Figure 42. BEAR Low Battery Indicator Circuit Diagram

4.4 BEAR Calibration Guide

BEAR A/D CARD SET-UP PROCEDURES

Refer to the "BEAR data Acquisition Circuit Schematic" for making these adjustments. The order in which the offset adjustments are to be made is as follows:

1. A/D Convert S55016 (U9)
2. A/D Buffer Amp OPA27EZ (U5)
3. Anti-Aliasing Filter 678-2K0 (U4)
4. Gain Block op Amp OPA-111 (U3)

Prior to making adjustments:

Turn the BEAR unit on and enter CALIBRATION MODE #2 by entering "*" "C" "2" on the keypad. Allow a 3 minute stabilization period before any checks or offset adjustments are made. The test points and adjustments ar located and are clearly marked on the A/D card accessible through the front panel hinged door.

CRYSTAL SEMICONDUCTOR CS5016 16 BIT A/D

Operational check:

1. With the BEAR unit in CALIBRATION MODE #2, the display will show the A/D output as a hex value.

2. Short the A/D input to ground by placing the jumper plug at JMP 4 over the middle and GROUND (silkscreened "G" designator) stakes.

3. The front panel display should read between 7FFF and 8000.

4. If the display reading is outside the 7FFF-8000 range, the A/D section is not operating correctly and needs to be repaired.

5. Reconnect the A/D input by reversing JMP 4 jumper plug.

BURR BROWN OPA27EZ A/D BUFFER AMP

Operational check:

1. Short the buffer Amp input to ground by placing a jumper plug at JMP 3 between the middle and GROUND stakes.

2. The front panel display should read between 7FFF and 8000.

3. If the display reading is outside the 7FFF and 8000 range, the A/D buffer Amp is not operating correctly and needs to be repaired.

4. Reconnect the A/D Buffer Amp input by reversing JMP 3 jumper plug.

FREQUENCY DEVICES 678-2K0 ANTI-ALIASING FILTER

Filter offset adjustment:

1. Short the filter input to ground by placing a jumper plug at JMP 2 between the middle and GROUND stakes.

2. Adjust the filter 20K ohm offset pot (R8) to obtain a front panel display reading that toggles between 7FFF and 8000.

3. Reconnect the filter input by reversing JMP 2 jumper plug.

BURR BROWN OPA-111 GAIN BLOCK AMPLIFIER

OPA-111 offset adjustment:

1. Short the signal input to ground by placing a jumper at JMP 1 between the middle and GROUND stakes.

2. Allow the A/C output reading to settle due to the charging of the 15uF D.C. blocking capacitor.

3. Adjust the OPA-111 offset adjustment pot R4 to obtain a front panel as close as possible to 7FFF to 8000.

4. Reconnect the signal input by reversing JMP 1 jumper plug.

5. Connect a PCB model 106M or 106B microphone to the BNC connector on the front of the BEAR unit. Insure that a jumper plug is installed at JMP 1 to connect the excitation voltage to the microphone. Place the microphone on a piece of foam and insert the microphone into the pistonphone calibrator (B&K type 4220 or equivalant) and to assure not to vibrate the microphone for the remaining adjustments.

6. Allow the A/D output reading to settle due to the charging of the 15uF D.C blocking capacitor.

7. Repeat adjusting the OPA-111 offset adjustment pot R4 to obtain a display reading as close as possible to 7FFF or 8000.

OPA-111 GAIN ADJUSTMENT

1. Enter the BEAR CAlIBRATION MODE #1 by entering "*" "C" "1" which calculates a sound pressure level (SPL) reading and displays it in dB.

2. Leave the microphone in the pistonphone calibrator laying on the foam and turn the calibrator on.

3. Adjust the OPA-111 gain pot R7 to obtain a display reading of 124.00 dB.

4. The microphone, used for the OPA-111 ofset and gain adjustments for a particular BEAR unit, must stay with that unit for accurate measurements.

5. After the calibration procedure is completed, close and secure the hinged door and the unit is ready for data acquisition.

4.5 BEAR Address Map

X = DO NOT CARES - = AS DECODED BY TARGET DEVICE

A23	A22	A21	A20	A19	A18	A17	A16	A15	A14	A13	A12	A11	A10	A9	A8	A7	A6	A5	A4	A3	A2	A1	ADDRESSES	COMMENTS
0	0	0	0	0	0	0	0	0	X	-	-	-	-	-	-	-	-	-	-	-	-	-	000000>003FFF	EPROMS
0	0	0	0	0	0	0	0	1	X	X	X	-	-	-	-	-	-	-	-	-	-	-	0080000>008FFF	SRAM
0	0	0	0	0	0	0	1	0	X	X	X	X	X	X	X	X	X	X	X	X	X	-	010000	ADC
0	0	0	0	0	0	0	1	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	018000	BAT RAM ON/OFF
0	0	0	0	0	0	1	0	0	X	X	X	X	X	X	X	X	X	X	X	X	X	-	020001>020003	DISP
0	0	0	0	0	0	1	0	1	X	X	X	X	X	X	X	X	X	X	X	X	-	-	028001>028007	PIA
0	0	0	0	0	0	1	1	0	X	X	X	X	X	X	X	X	X	X	X	-	-	-	03001>03000F	PTM
0	0	0	0	0	0	1	1	1X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	03800	SPARE2
1	0	0	0	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	800000>81FFFF	BRAM P#1
1	0	0	0	0	0	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	820000>83FFFF	BRAM P#2
1	0	0	0	0	1	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	840000>85FFFF	BRAM P#3
1	0	0	0	0	1	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	860000>87FFFF	BRAM P#4
1	0	0	0	1	1	0	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	8C0000	RUNNING AVG RAM
1	0	0	0	1	1	1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	8E0000	RUNNING AVG RAM

NOTES:
Only the lowest possible addresses are shown for devices accessed with partial decoding
(those that contain "do not cares")
Spare #2 is a synchronous address block

4.6 BEAR Voltage to Sound Pressure Level Conversion

The BEAR systems are set up with the lowest A/D count set equal to 75.0 dB overpressure with the normal 20 micropascal reference. This makes the BEAR's full A/D count to be over 76 Pounds per Square Foot (PSF) and over 165 dB overpressure.

BEAR SYSTEM VALUES

A/D COUNT	DB	PSF	A/D VOLTAGE
1	75.0	0.002	0.000305
2	81.0	0.005	0.000610
3	84.5	0.007	0.000916
4	87.0	0.009	0.001221
5	89.0	0.012	0.001526
6	90.6	0.014	0.001831
7	91.9	0.016	0.002136
8	93.1	0.019	0.002441
9	94.1	0.021	0.002747
10	95.0	0.023	0.003052
11	95.8	0.026	0.003357
12	96.6	0.028	0.003662
13	97.3	0.031	0.003967
14	97.9	0.033	0.004273
15	98.5	0.035	0.004578
16	99.1	0.038	0.004883
17	99.6	0.040	0.005188
18	100.1	0.042	0.005493
19	100.6	0.045	0.005799
20	101.0	0.047	0.006104
21	101.4	0.049	0.006409
22	101.8	0.052	0.006714
23	102.2	0.054	0.007019
24	102.6	0.056	0.007324
25	103.0	0.059	0.007630
26	103.3	0.061	0.007935
27	103.6	0.063	0.008240
28	103.9	0.066	0.008545
29	104.2	0.068	0.008850
30	104.5	0.070	0.009156
31	104.8	0.073	0.009461
32	105.1	0.075	0.009766
33	105.4	0.078	0.010071
34	105.6	0.080	0.010376
35	105.9	0.082	0.010681
36	106.1	0.085	0.010987
37	106.4	0.087	0.011292
38	106.6	0.089	0.011597
39	106.8	0.092	0.011902
40	107.0	0.094	0.012207

BEAR SYSTEM VALUES

dB	PSF	A/D VOLTAGE	A/D COUNT
105.0	0.074	0.009651	32
106.0	0.083	0.010828	35
107.0	0.094	0.012150	40
108.0	0.105	0.013632	45
109.0	0.118	0.015295	50
110.0	0.132	0.017162	56
111.0	0.148	0.019256	63
112.0	0.166	0.021605	71
113.0	0.187	0.024242	79
114.0	0.209	0.027200	89
115.0	0.235	0.030519	100
116.0	0.264	0.034242	112
117.0	0.296	0.038421	126
118.0	0.332	0.043109	141
119.0	0.372	0.048369	158
120.0	0.418	0.054270	178
121.0	0.469	0.060892	200
122.0	0.526	0.068322	224
123.0	0.590	0.076659	251
124.0	0.662	0.086013	282
125.0	0.743	0.096508	316
126.0	0.833	0.108284	355
127.0	0.935	0.121496	398
128.0	1.049	0.136321	447
129.0	1.177	0.152955	501
130.0	1.321	0.171618	562
131.0	1.482	0.192559	631
132.0	1.663	0.216055	708
133.0	1.866	0.242417	794
134.0	2.094	0.271997	891
135.0	2.349	0.305185	1,000
136.0	2.636	0.342423	1,122
137.0	2.957	0.384205	1,259
138.0	3.318	0.431086	1,413
139.0	3.723	0.483686	1,585
140.0	4.177	0.542705	1,778
141.0	4.687	0.608924	1,995
142.0	5.259	0.683224	2,239
143.0	5.900	0.766590	2,512
144.0	6.620	0.860129	2,818
145.0	7.428	0.965080	3,162
146.0	8.334	1.082838	3,548
147.0	9.351	1.214964	3,981
148.0	10.492	1.363212	4,467
149.0	11.773	1.529549	5,012
150.0	13.209	1.716182	5,623

BEAR SYSTEM VALUES

dB	PSF	A/D VOLTAGE	A/D COUNT
151.0	14.821	1.925588	6,310
152.0	16.629	2.160546	7,079
153.0	18.658	2.424172	7,943
154.0	20.935	2.719965	8,913
155.0	23.489	3.051852	10,000
156.0	26.356	3.424234	11,220
157.0	29.572	3.842053	12,589
158.0	33.180	4.310854	14,125
159.0	37.228	4.836859	15,849
160.0	41.771	5.427045	17,783
161.0	46.868	6.089243	19,953
162.0	52.586	6.832245	22,387
163.0	59.003	7.665907	25,119
164.0	66.202	8.601284	28,184
165.0	74.280	9.650798	31,623
165.3	76.970	10.000000	32,768

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